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THE NIAGARA INSTITUTE MEETING.

The general meeting last week at Niagara of the American Institute of Electrical Engineers made a record of which the body as a whole may well be proud, and which reflects the highest credit upon President Scott and the members of the various committees who co-operated with him in organizing and conducting the meeting. The attendance reached the high-water mark, the number of guests and members registered falling but little short of 500. In the past the attendance at the general meetings of the Institute was largely made up of the same members from year to year, but at Niagara, while the "old guard" was well represented, the registry list and the new faces gave evidence of the recent great expansion of the membership which has been such a remarkable feature of the past year. It may here be remarked that one of the incidental though important benefits from the numerous local branches which have been instituted throughout the country, should be that of bringing this new element in direct touch with the active life of the Institute, thus not only enabling them to participate in its work through their local branches, but inciting their interest in the general meetings, which should give to the annual gathering a greatly increased value. A notable feature of the Niagara meeting was the admirable local arrangements made for the meeting and for the entertainment of visiting members and their families, the members of the local committee being particularly untiring throughout the meeting in their efforts to render the gathering an unqualified success from the social standpoint—in which they amply succeeded. We cannot refrain from paying a tribute to President Scott in his capacity as a presiding officer. Though with almost two score of papers on the programme, it was disposed of without a hitch, and yet with proper allowance made for discussion. It is needless to say that this implies upon the part of the presiding officer a firm grasp of the situation and an efficient exercise of parliamentary control, which in this case was unaccompanied by friction.

Owing to the large number of papers read and the length of some of the discussions, it would be impracticable to give a complete report of the proceedings in one issue. We are consequently obliged to divide our report in two portions, the second of which will appear next week. The average of the papers, notwithstanding their number and the slightness of a few, is extremely good. Two of the groups —those treating of electric railway and high-tension transmission subjects—form in fact extremely important contributions of permanent value to these respective subjects. The papers by Messrs. Armstrong, Carter and Renshaw, and the discussions which accompanied them, will go far toward placing in a definite and final state the problems of which they treat. Indeed, these, taken with papers on similar subjects presented at Great Barrington and Buffalo, present a mass of data and expressions of individual views of authorities that should place at the service of a competent author sufficient material for generalizations in, and a systematic exposition of, this branch of electrical engineering, which is badly in need of such a treatment. We hasten to add that this is not said in disparagement of the contributions to which we refer, as these represent the work of specialists on problems presented to them specifically in the successive stages of electric railway engineering development; and as collections of data and expressions of authoritative views they are of the greatest intrinsic value. It does appear, however, that the time is ripe to base upon this material and upon the investigations of others

a systematic treatment for the student and for the electric railway engineer who has not had an opportunity to specialize in that particular field.

Of equal importance to the railway contributions and perhaps of more general interest, is the group of papers on high-tension power transmission and the accompanying discussion. In this connection we desire to point out the wisdom of placing in charge of a member who is a specialist in a subject, the preparation of a programme of papers on that subject. In this instance, such responsibility was placed with Mr. Ralph D. Mershon and with results so excellent that we hope the practice may become fixed in the conduct of the Institute. Two papers on alternating-current apparatus of diametrically opposite character were presented, those of Prof. W. S. Franklin on the synchronous converter and by Mr. W. L. Waters on commercial alternator design—the former being extremely theoretical and mathematical in character, and the latter a model of a paper written for an audience of engineers. The paper by Prof. J. Walter Esterline and Mr. C. E. Reid, giving investigations of the energy losses in armature cores, is an excellent example of the contributions being made to engineering from the college laboratory equipped for experimental work. Another example of the value of the college to engineering is illustrated in the several papers by Prof. Goldsborough and Mr. P. A. Fansler on electric railway and power station tests. Perhaps the two most striking technical incidents of the Niagara meeting were the description by Prof. H. J. Ryan of his cathode ray alternating-current wave tracer and the presentation by Mr. P. H. Thomas and Mr. M. von Recklinghausen of the several inventions of Mr. Peter Cooper Hewitt. A report of the latter will be found in this issue, and editorial reference to the former appears in another column. In following issues a number of the Niagara papers will be taken up for comment.

THE COMMERCIAL LIMITS OF POWER TRANSMISSION.

With all the valuable discussion of power transmission which the recent Institute meeting elicited, there is a broader phase of the commercial question which has as yet hardly received due consideration from engineers. It is comparatively easy, albeit somewhat risky like all prophecy before the fact, to figure out for any given set of conditions the maximum distance at which power transmission will pay, the maximum feasible voltage in the present state of the art, and even the most economical size of conductor to employ. But all these results, however useful in themselves, are confined to the present epoch, to the conditions true in the year of grace 1903, while the investments demanded must be, if commercial success is to be attained, sound and intact in 1925 or 1950. We are well aware that in the minds of many, commercial success begins and ends with the placing of certain securities with a proper bonus and profit to the underwriters, but the lessons of the past twenty years we have not yet quite forgotten, and we confess to belonging to that small band of fanatical ultra conservatives who hold that honesty is the best policy, and that exploiting as sound, a project that will infallibly be wrecked within ten years, is not an honest man's work. If electrical power transmission is to have the place in the world's future that we believe of right belongs to it, it must not be quite reckless of the future and of the effect of time in changing conditions. To be thoroughly sound a project must not only give a safe prospect of dividends in the immediate future, but of such continuance of them in spite of depreciation and change in the art, as will leave the securities of full value at maturity.

Just now we are in this country on the crest of a wave of financial prosperity such as never before in the country's history has been equalled. That this condition is permanent the most sanguine cannot maintain, and ere long we must be prepared for a recession. Therefore, in undertaking a work like power transmission, it is merely common caution to look forward and estimate the reasonable probabilities of the future. Once installed, a plant must at least earn its upkeep, running expense and fixed charges, even in times only moderately prosperous in order to score a moderate success. One of the first things, therefore, to be taken under consideration is the integrity of the market. A few miles more or less, a few thousand extra volts, or a few tons of copper are of inconceivably small significance compared with the solidity of the earning capacity. And strange to say, on no single point in the conduct of the transmission business do more good men go wrong. We have in mind, for instance, a hydraulic transmission plant which is doing a rapidly growing business. There is rather severe competition, prices are low and hard to increase. The plant has a large and increasing motor business from which a large amount of its revenue is derived. So urgent have calls for power become that a steam auxiliary plant of imposing dimensions was erected to meet the expansion, regardless of the fact that if prices are so low so that neither steam power nor hydraulic power can fairly meet them, no combination of these sources can help the matter. Now the peculiarity of the situation is that the small motor business is mostly among small manufactories engaged in the same line of work, and at the first pinch of hard times three-quarters of them will shut down, as they have done before, and leave the plant with a heavy investment to stagger under and a greatly diminished business.

This is but one type of the improvidence which too often leads to disaster. A plant which supplies such a community, or a booming town dependent for its prosperity on a few big enterprises, is a bad market. In some few cases, as in mining towns, a plant may be installed wittingly as a pure speculation, designed to clear enough profit before the end of the chapter to let out the investors even if the plant is scrapped. This is gambling, not investment, and in general it takes great judgment to tell how far a mining town is a sound market for anything except wild-cat stock. But mining camps are not at all in a class by themselves in this matter, and it must be borne in mind that a safe market is the only security which stands behind a transmission plant. Its physical assets are difficult to realize upon, and do not often in themselves afford what one would call gilt-edged security. One of the wildest schemes which we ever remember to have emanated from a supposedly sane person was a plan for developing the great Falls of the Zambesi in Africa, using the copper of the line as security to the creditors. Now the Falls of the Zambesi will some day be developed, and the dark continent may become the center of civilization when the failing fuel supply shall have driven men from the colder zones, but not upon that basis. Copper in ingots laid away in a convenient storehouse is pretty good security up to a reasonable percentage of its market value, but as a high voltage line strung through a tropical jungle with international complications to prevent its being taken down, it is about as valuable security as a second mortgage on the North Pole. When the day comes in which Rhodesia and the surrounding lands support a population that calls for a hundred thousand horse-power to use in its manifold industries, the mighty African cataract will have its turn at the game. Given a market and the investment will take care of itself.

CATHODE RAY ALTETNATING CURRENT WAVE INDICATOR.

Among the papers read last week at the A. I. E. E. convention was one by Professor Ryan, on a current-wave indicator operating by cathode rays. This describes a new and interesting application of

the cathode rays. There are a variety of instruments which have been devised to leave a record of the outline of alternating-current waves. Some of these instruments are called oscillographs. An oscillograph, as ordinarily constructed, is a galvanometer with a very small natural period of vibration, so that it is able to follow every alternation of current without sensible inertia disturbance. When such a galvanometer is connected to an alternating-current circuit, its reflected spot of light is seen by persistence of vision to be drawn out into a long band, as the beam ranges cyclically from one end of the scale to the other. By watching this band of light in a rapidly revolving mirror, the band becomes optically analyzed into a series of waves of the outline corresponding to the current in the galvanometer coils. The image is often recorded by photographing the luminous trace.

In place of the oscillating beam from the galvanometer, Prof. Ryan employs a cathode beam impinging on a fluorescent screen, and caused to oscillate by the magnetic influence of coils supported close to the walls of the tube and traversed by the alternating current. The cathode beam is spread out into a band, similar to the galvanometer band. Similarly the cathode beam may be analyzed optically by a revolving mirror. Prof. Ryan prefers, however, to dispense with the revolving mirror, and employ a known perpendicular component of motion to obtain a cyclically re-entering closed curve of light, or, in fact, an indicator diagram. The engine indicator diagram combines a cyclically varying component of motion of excursion proportional to the instantaneous steam pressure in the cylinder, with a perpendicular motion obtained from the piston. In Prof. Ryan's apparatus the perpendicular component is not a uniform to-and-fro movement, but a simple harmonic movement, or pendulous movement. This is obtained by using another pair of coils magnetically acting upon the cathode beam perpendicularly to the first pair, and exciting these with an alternating current from which the harmonics have been practically all weeded out by the aid of resonance. It is the same sort of diagram as would be obtained from the steam engine cylinder if the horizontal component of motion were a simple harmonic motion, or were taken from an eccentric driven by the uniformly rotating engine shaft.

The cathode ray diagram may be photographed. It has then to be expanded horizontally to reduce the simple harmonic motion to corresponding uniform motion. This may be done either with the aid of specially prepared ruled paper, in which the spacing of abscissas follows the inverse of the simple harmonic law; or, the same result may be obtained by a method of projections described in the paper. It is curious to observe that no such reduction of the diagram to uniform motion would be needed if the base component of alternating current were adjusted to the simple triangular or saw-toothed form, instead of to the simple harmonic form. The instrument has the advantage that the cathode rays are practically inertialess, and thus respond fully and immediately to fluctuations in the current strength. On the other hand, it takes several seconds of exposure and cyclic repetition to secure a photographic record. The instrument is remarkable as requiring double excitation, namely first by high pressure or Winshurst machine, with a cathode ray-producing current of about half a milliampere; and second by the base component of simple harmonic current of about one ampere. While the oscillograph has the advantage over the apparatus of Prof. Ryan in giving a direct trace of a wave, which trace can be observed continuously, the latter admits of adjustment whereby a detail of a wave which it is desired to study may be exaggerated.

THE FORTHCOMING INTERNATIONAL ELECTRICAL CONGRESS AT ST. LOUIS.

At the Niagara Falls convention of the American Institute of Electrical Engineers last week, the Committee on Organization of the St. Louis Electrical Congress held a preliminary meeting. It was resolved that an International Electrical Congress should be held at St. Louis early in September, 1904, in connection with the St. Louis Universal Exposition. A resolution was also passed to the effect that, in the opinion of the committee, official delegates to this congress should be invited by the United States Government from the various foreign governments. We understand that a number of sub-committees have been already appointed to take up the various aspects of the proposition.

It is earnestly to be hoped that the plan thus formulated, and entered upon its initiatory stage, may be brought to a successful issue. It is of great importance to international sociology in general, and to international electrical interests in particular, that an official electrical congress should be held next year at St. Louis in conjunction with a general electrical congress. There are various questions of international technological importance, relating to electrical units and standards, that await determination at the hands of the next official electrical congress. Even although no decision should be reached upon most of these questions, great advantage would accrue to decision upon the remainder. The State Department at Washington will, no doubt, have proper representations made to it concerning the national importance of the matter. The various foreign governments should be invited to appoint and send a specified number of representatives to the chamber of delegates of the congress, the sessions of which would probably not occupy more than a week in all. The same course was followed in conjunction with the International Electrical Congress at the Chicago World's Fair in 1893. At that time Great Britain, France, Germany and Austria were all invited by the United States Government to send five delegates each. Belgium, Italy and Switzerland were invited to send three delegates each, and various other countries a yet smaller number. Most of the important countries responded to the appeal, and the congress which assembled was one of the most important in electrotechnical history. It established the international ohm, volt, ampere, coulomb, farad and henry. Only one official electrical congress has been held since the Chicago congress of 1893, and that was at Paris in 1900, in conjunction with the Universal Exposition there. Substantially the same course of official procedure was followed in that instance also.

As regards the electrical general congress at St. Louis, it is expected that this will be held in conjunction with simultaneous conventions of the electrical organizations of the country, such as the American Institute of Electrical Engineers, the American Electrochemical Society, the National Electric Light Association, the Association of Edison Illuminating Companies, and others. In this manner each of the various sections of the congress might be expected to co-operate, on a certain day or days, with the particular technical body to which that section is appropriate, so that the best papers and their fullest discussion might be obtained. The membership list of the Paris Electrical Congress contains about 900 names. There were no simultaneous conventions of prominent allied organizations held in conjunction with that congress. A greater membership roll might be expected with the aid of simultaneous conventions. It may be added that at the recent International Chemical Congress held in Berlin, more than 2,500 names were enrolled.

Street Railway Statistics of the United States.

In our issue of May 9 was given a brief abstract of the statistics of the street railways of the United States of America, as compiled by the Census Office from the returns collected last year. Director of the Census North has given out to the press this week the complete bulletin on the subject as prepared by Messrs. T. C. Martin and E. Dana Durand under the supervision of Chief Statistician Steuart. It is a voluminous and most interesting document, but is chiefly statistical, the detail text, discussing the various results, being intended to appear in the final report, which the Census Office aims to make a most complete and exhaustive treatment of the subject. As it is, the fullness of the work may be inferred from the statement that from all except 22 companies complete returns were obtained.

Having already given the gross figures, it is necessary only to recapitulate here; while some details and tables will be presented in our next issue. During the period covered by this inquiry there were in existence 817 operating street and electric railway companies and 170 companies leased to and operated by other companies, making a total of 987 companies. These companies owned 22,576.99 miles of single track. The par value of the capital stock and funded debt outstanding as reported amounted to $2,308,282,099. The average net capital liabilities per mile of single track owned for the companies reporting both factors were $96,287. The total income and expenses of the operating companies amounted to $250,504,627 and $219,907,650, respectively. The companies gave employment on the average during the year to 133,641 wage-earners and paid $80,770,449 in wages. There were 7,128 salaried officials and clerks employed, to whom $7,439,716 was paid as salaries. The roads carried 5,871,957,830 passengers of all kinds.

Unfortunately, a number of the street railway companies in existence at the census of 1890 failed to make reports to the Census Office, and, therefore, a comparison of the statistics of the two censuses will be, to that extent, defective, exaggerating somewhat the growth which actually took place. From the items as reported it appears that the single-track mileage increased from 8,123.02 miles in 1890 to 22,576.99 miles in 1902, or 177.94 per cent., and the number of fare passengers carried from 2,023,010,202 to 4,809,554,438, or 137.74 per cent.

The Electronic Theory of Matter.

On June 5 Prof. Crookes delivered an address before the Congress of Applied Chemistry at Berlin on "Modern Views on Matter," in which he discussed the ultimate nature of matter and energy. A quarter of a century ago Prof. Crookes, speaking before the Royal Society on the subject of rays emitted from exhausted tubes and the radiant property of matter at this low density, made the following observation: "We have actually touched the border land where matter and force seem to merge into one another—the shadowy realm between the known and unknown." He considers that the greatest scientific problems of the future will find their solution in this borderland, and even beyond: "here it seems to me, lie the ultimate realities, subtle, far-reaching, wonderful."

When president of the Chemical Society in 1888 Prof. Crookes pointed out the possibility of the genesis of the elements from "the formless mist" of ultimate matter. He strove to show that the elementary particles themselves might not be the same as when first generated; that the primary motions which constitute the existence of the atom might slowly be changing, and, in a word, the elementary particles, so far from being themselves eternal in existence, might share, with the rest of creation, the attributes of decay and death.

Now comes the electric theory of matter, and one of the earliest definite suggestions of this conception came from the pen of Dr. W. K. Clifford in the *Fortnightly Review*, for June, 1875. "There is," said Dr. Clifford, "great reason to believe that every material atom carries upon it a small electric current, if it does not wholly consist of this current."

Next came an army of experimenters, which, working upon the definite law of Faraday and the theories originally due to Weber, evolved the modern ultimate particle of electricity, the "electron," and which they found could exist separately. Then Prof. Crookes showed that the cathode rays consisted of a stream of negatively charged particles, the other contents of the tube being positively electrified. Then came the work of Lenard and Röntgen, who showed that the phenomena outside the tube surpassed in interest that which took place inside. Thus had been established the hurling power of electrically charged particles at a speed approaching that of light by electrically charged bodies themselves. But in 1896 Becquerel and later M. and Mme. Curie and M. Bémont, working upon the emanations of uranium and the other substances associated with it, were able to show that these emanations were of a nature very similar to Röntgen rays, being able to penetrate many substances in an almost exactly similar way. Then came the crowning point—radium.

Much light has lately been thrown upon the nature and habits of these tiny particles—electrons—their size and velocity, for instance, having been deduced from trustworthy data. The mass of such an electron may be taken as one seven-hundredth of that of the atom of hydrogen, until lately the lightest body known, or at about 3×10^{-26} grm. and its velocity at 2×10^{9} cms. per second, or two-thirds that of light. The kinetic energy per mgm. is thus 10^{17} ergs, or about three and a half million foot-tons. Becquerel has calculated that one square cm. of radioactive surface would radiate into space one grm. of matter in a billion years. The positively charged atoms or ions are the electrons, and according to Sir O. Lodge may be compared to the solar system, in which the electrons are represented by the planetoids. Thus the great penetrative power of these electrons is accounted for by their minuteness as compared with the space between them, but in their rush forward they must ultimately collide with something. The negative ones arrested by a barium platino cyanide screen will exhibit phosphorescence, the heavier positive ions will more effectively cause phosphorescence of a Sidot's zinc sulphide screen.

Although Röntgen rays and electrons penetrate various substances and act on a photographic plate, the former have much more penetrative and photographic action.

According to Sir Oliver Lodge's electronic theory of matter, an atom or ion has a few extra negative electrons in addition to the ordinary neutral atom, and if these negative electrons be removed it thereby becomes positively charged. The negative charge consists of superadded or unbalanced electrons—one, two, three—according to the valency of the body, whereas the main bulk of the atom consists of paired groups, equal positive and negative. As soon as the excess of electrons is removed, the rest of the atom, or ion acts a positively charged body hanging tightly together. In a high vacuum the spark tears the components of the rarified gas apart: the positively charged ions, having great comparative density, are soon slowed down by collisions, while the electrons are driven from the negative pole with an enormous velocity depending on the initial e.m.f. and the pressure of gas inside the tube, but approaching, at the highest exhaustions, half that of light.

Prof. J. J. Thomson, in his remarkable paper published in 1881, developed the idea of electric inertia, that is self-induction, and attributed to the electron, that most vital property. Thus, when an atom is regarded as merely a congeries of electrons, a non-material, so to speak, explanation of matter is at once forthcoming and an electrical theory of inertia, that is all intertia.

Prof. Crookes then went on to describe at length the scintillations observed on a zinc sulphide screen when a drop of a radium salt solution is placed upon it, or a piece of the solid salt allowed to remain in close proximity to the screen. The consequent phosphorescence is effected alike at the ordinary temperature or at that of liquid hydrogen, in the air or in vacuo, and to the naked eye appears as a sort of "milky way" and under the microscope as a bombardment of splashes, each forming momentarily a luminous halo with a dark center. These scintillations are probably only the splashing of the positive ions hurled off by radium with a velocity of the order of that of light and made apparent by the enormous extent of lateral disturbance produced by its impact on the sensitive surface.

In conclusion, Prof. Crookes asked: "Are we not incessantly learning the lesson that our researches have only a provisional value? A hundred years hence shall we acquiesce in the resolution of the material universe into a swarm of rushing electrons? This fatal quality of atomic dissociation appears to be universal, and operates whenever we brush a piece of glass with silk; it works in the sunshine and rain drops, and in the lightnings and flame; it prevails in the waterfall and the stormy sea. And, although the whole range of human experience is all too short to afford a parallax whereby the date of the extinction of matter can be calculated, protyle, the 'formless mist,' once again may reign supreme, and the hour hand of eternity will have completed one revolution."

Station Indicators for Subway, Elevated and Other Railway Systems.

By ERNEST K. ADAMS, E. E.

INDICATORS for announcing the next station upon street car lines have been brought out from time to time, but, on account of their complicated construction, have not been successful. These indicators have been operated at different streets, either manually or automatically, and in the latter case by mechanical combinations which have been controlled by the revolution of the car wheels, projections from the track or other similar devices. The application, therefore, of indicators to street cars is of doubtful utility.

For subway, elevated and certain other railroad systems the case is different. Here the stations are comparatively far apart, and the presence of gatemen or guards upon the platforms of the cars makes it feasible to operate the indicators manually. There is no doubt but that a simple and practical station indicator car equipment, under suitable conditions, would be a convenience to and a desideratum by the public; for everyone, especially a stranger, is familiar with the difficulty in recognizing the approach of the station at which he desires to alight, either from the surroundings or the inaudible reminder that is given to the door-jamb by the platform attendant. It may almost be said that the thought: "What is the next station"? occurs somewhere every minute of the day.

FIG. 1.—VIEW OF STATION INDICATOR AND CONTROLLER ON CAR.

The purpose herewith is to show a number of mechanical and electrical station indicators that are adapted, besides to certain railroads, to the elevated and subway transportation lines of New York and other cities. Both indicator systems, which are designed to be manually controlled from the platforms, with indicators mounted over the doors of the car where they may be easily read from any seat within, have an intermittent driving mechanism, enabling the rolls upon which the printed strips are wound to be both operated by a rotary motion and locked after the same. This rotary motion feature simplifies the indicator equipment, for, in the case of the mechanical indicators, in order to reverse the direction of the movement of the printed strips when the end of the route is reached, it is only requisite to reverse the direction of the motion at the controllers upon the platforms. Thus, going downtown, the guard turns the handle of one of the controllers of his car one revolution in a given direction as the train leaves a station, and in the opposite manner going uptown. The reversal of the direction of the movement of the strips in the electrical indicators is performed by a switch. Applications of similar indicators to other purposes than those above specified may be found upon certain boat lines and in general advertising.

By reference to Figs. 1 and 2, which give the general details of the mechanical indicator equipment that was installed in the New York Subway experimental car, "John B. McDonald," the arrangement of the system may be readily followed. The indicators, which are of substantial construction and provided with black station designations upon white strips, are mechanically connected by a hollow shaft, together with miter gearing, the said shaft extending throughout the length of the car and supported at intermediate points by brackets. These brackets may be incorporated in those which support one of the strap rails of the car, or the shaft may pass directly through the strap rail when desired. In this latter case the strap rail would be made of tubing.

Each controller, which is mounted at the extreme end of the car so that the gatemen need hardly move when operating the controllers of adjacent cars, is connected with the main shaft of the equipment by two sprockets and a heavy chain, this chain being capable of working through an angle of 90°. The ratios of the sprockets are such that one revolution of the handle of either controller will bring a new station name into view at the indicators. The intermittent gearing in each of the indicators is so arranged that the printed strips are advanced their given amount during the middle of the revolution of the controller handles. Thus it is not absolutely essential that a controller handle shall be left in a certain position, and furthermore the indicators within will not be disturbed by any vibration of the car.

The controllers are provided each with an indicating device, which enables the guard upon the platform to be informed of the condition of the indicators inside without actually looking at them, as would be sometimes necessary when the cars are unduly crowded. This indicating device consists of a planetary combination of gears, which permits any number of stations to be consecutively shown at an opening in the controller casting. This opening is designed to coincide with a similar opening in the controller lever, and in the daily operation of the equipment the guard will leave the controller handle in the position where the station name is observable through the opening in the aforesaid lever.

A stopping arrangement is also incorporated in one of the controllers of the car equipment for the purpose of preventing the gateman from running the printed strips off the rollers in the indicators. This device embodies a traveler, which is mounted upon a threaded portion of the controller spindle, and, while prevented from turning by the configuration of the adjacent support, it is allowed an up and down motion between certain limits, as determined by two adjustable stops fastened to the controller spindle.

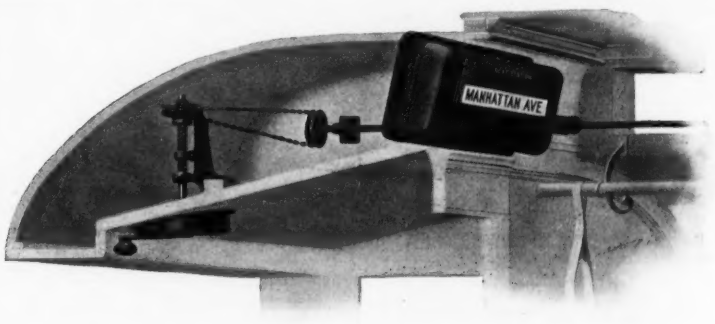


FIG. 2.—PERSPECTIVE VIEW OF STATION INDICATOR AND CONTROLLER.

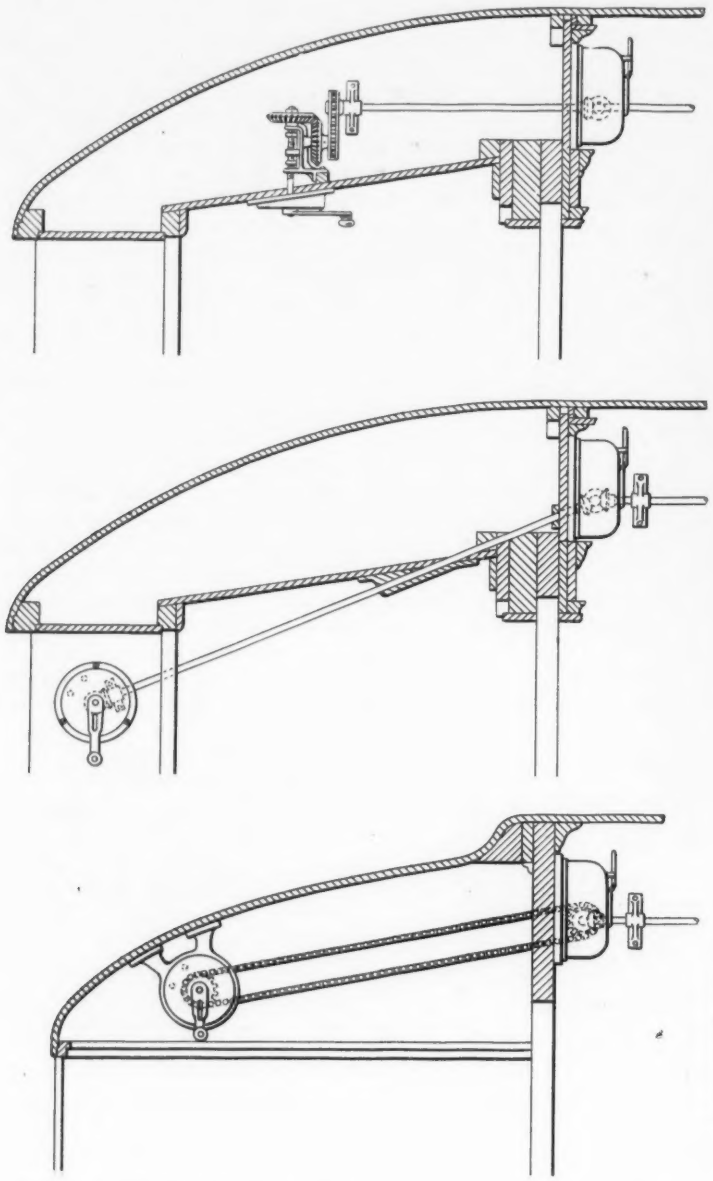
A stamped metal flap, having the words "Next Station" embossed thereon, is hinged upon the front of each indicator, and normally held upward by two spring catches. When it is not desired to operate the indicators of a car, on account of a change of route, break-down or other reason, these flaps may be released and made to cover the openings in the indicators.

The number of stations that each of the above indicators is capable of accommodating, with two-inch letters for the station names, may be made, when required, approximately one hundred. The indicators may, therefore, be provided with station names of minor branches of the main road, upon which it is intended to operate the

system, and when these additional names are required, the indicators may be quickly advanced or brought back to their proper positions. Attention has been given to the printed strips, both as regards their material, construction, feeding arrangement and means of preventing them from slipping off the rolls, upon which they are wound.

In this indicator system, where dependence upon manual control is observed, a considerable amount of complicated mechanism is avoided, and at the same time the equipment is placed in a different position from that of a fully automatic device. The extent and cost of the alterations required when installing the system in a car are moderate.

Several modifications in the controlling portion of the indicator equipment, which are adapted to cars of varying construction, are shown in Figs. 3, 4 and 5. Thus in Fig. 3 the necessity of employ-



FIGS. 3, 4 AND 5.—SECTIONAL ELEVATIONS OF MODIFIED CONTROLLERS.

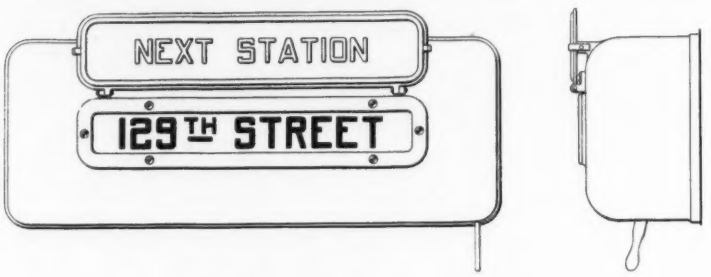
ing a twist in the driving chain is obviated. The employment of a chain working through an angle of 90° has been found in continuous operation to work well; but it may be replaced when desired by a mitre gear, sprocket wheel and bicycle chain combination, the other parts of the controller being the same as before.

When it is advantageous to mount the controllers in vertical positions at the ends of the car, a construction, similar to that given in Fig. 4 may be taken advantage of. This construction includes a number of miter gears and a connecting shaft, suitably journaled at each end. The controller in this case is made up of the spindle and handle as before, together with a cylindrical case for holding the planetary indicating device. The stopping function for preventing the strips from being overwound is taken care of by two pins, which are mounted between the two gears of the planetary combination.

For a car having an open platform, such as are often found in elevated and railroad lines, a simple indicator controller is shown in Fig. 5. Here the controller is provided with two extensions, which are secured to the roof, the driving media embodying sprocket wheels, bicycle chain and mitre gears. The same stopping device is herein employed in the planetary combination of the controller as that shown in the preceding figure.

A testing machine, shown in Fig. 6, has been employed for determining in the laboratory the wearing qualities of mechanical station indicators. This device makes it possible in a few weeks to give an indicator equipment a test which is equal to several years of actual service. The arrangement is such that the handle of one of the controllers of the indicator system is given a quick turn, and

FIG. 6.—LABORATORY TESTING MACHINE FOR STATION INDICATORS.



FIGS. 7 AND 8.—FRONT AND SIDE ELEVATIONS OF INDICATOR.

allowed to rest for a short interval before being again revolved, as would be the case in daily employment. The device may be set for any given number of stations up to one hundred, and will automatically reverse at the first and last stations. An indicator equipment, similar to that installed in the already mentioned experimental car for the New York Subway, has been tested with the above machine many thousand times without perceptible wear.

By making the station indicators electrical in their operating function, several advantages are gained, with nearly the same first cost as in the mechanical types. These are the conveniences to be found in adapting the indicators and controlling switches to any form of car, together with the possibility of operating the indicators under a multiple unit system of control. In this case a switch is

mounted upon each platform of a car, and by the closing of any one of the aforesaid switches upon a train of cars, the entire series of indicators will be simultaneously advanced one station. The control of the indicators may be given to the engineer in charge of the train or to a subordinate. For the wiring of the system only one extra flexible conductor is required to pass between adjacent cars. Obviously, the indicators of a car may be wired independently of the adjacent cars, in which event each indicator equipment would be controlled by the gateman or guard of that particular car.

The electrical indicator, shown in Figs. 7 and 8, is of substantially the same outward appearance and internal construction as the mechanical ones; but is provided with a comparatively heavy electric motor, magnetic brake, carbon contact, reversing switch and device for preventing the strip from being over wound. This combination gives a simple and positive indicator construction. The lever of the reversing switch is allowed to project through the case of the indicator, and when the end of the route is reached, in either direction, the guard is required to simply move over the aforesaid lever for the return trip.

A convenient form of switch for operating the electrical indicators is illustrated in Fig. 9. This device, embodying heavy carbon contacts and actuated by a cord, is adapted to be mounted upon the woodwork of a car in any desired location.

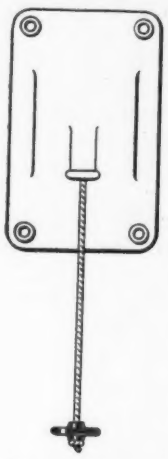


FIG. 9.—ELEVATION OF CONTROLLING SWITCH.

In the above electrical indicator equipment each indicator is operated by a separate electric motor. However, by employing one of the already described mechanical indicator systems, minus the controlling portions, an electrical equipment can be made with but one electric motor. This motor would be arranged to drive the connecting shaft of the indicators by worm or other suitable gearing, the motor perhaps being situated upon the roof outside of the ventilators in the center of the car. The reversing switch for the motor may be conveniently placed in the supporting element for the drive between the aforesaid motor and the indicator connecting shaft. A number of controlling switches, similar to the one shown in Fig. 9, would be employed for operating the system. This arrangement may be further extended and made to operate on the multiple unit plan. An electropneumatic system of station indicators may be also developed, but if electricity is to be employed, it is thought preferable not to complicate it by the addition of compressed air.

It would appear that, with the advent of subway and elevated railroads in different cities of the world, the time is opportune for the consideration by car manufacturers of the station indicator subject. It is believed that in many places the public needs station indicators.

The Sault Ste. Marie Power Canal.

A newspaper dispatch from Detroit last Saturday gave a somewhat alarming report of the condition of the new power plant at Sault Ste. Marie. According to the report of Lieut.-Col. N. A. Bartlett, who has just returned from the "Soo," when the water was let into the canal in order to test the plant informally, about five months ago, it was discovered that there was quicksand beneath the foundation of the power house. The action of the current of water upon this quicksand was such, it is alleged, that the whole foundation was threatened, and it was found necessary to shut off the water at once. On Sunday last a Philadelphia dispatch contained a statement made by two stockholders of the Consolidated Lake Superior Company, one of them a director, regarding the trouble. They admitted that a part of the foundation of the power house had been undermined, but declared that it was a trivial matter, and that repairs had already been effected. In a month or six weeks, they stated, the water will be again turned on. They think that the damage was principally due to an old water course which the pressure of the water in the canal had reopened. It was estimated that the necessary repairs would cost about $50,000. Piles have been sunk, the foundation has been replaced and the building is again in safe condition.

The Mechanical Cause of Gravitation

BY ROBERT STEVENSON.

AS we have shown from the nozzle experiment, it is quite possible to make a ball describe an elliptical orbit in space by mechanical means, without the hypothesis of the mutual attraction of matter. It now behooves us to show that nature produces the elliptical orbits of the planets and satellites in a similar manner.

If we simply assumed the philosophical fact, "That what man can do, it is not impossible for God to do," we would have a logical right to conclude that the probable cause of orbital motion in nature is mechanical work or energy; because we saw from the experiment that it required power to produce the orbital motion of the balls, although it does not require power in free space to keep up that motion, no more than it requires force to keep up momentum.

But as natural philosophy does not accept logic for its data, nor does it accept philosophical reasons as a criterion for its facts, unless supported by experiment, or the mathematical reasoning which is based on experiment, we will not even accept Newton's dictum, given in the "Principia," Rule 1, Book III:

"We are to admit no more causes of natural things than such as are both true and sufficient to explain their appearances."

According to that, if mechanical power will produce gravity, it is not necessary to admit the necessity for the occult force of attraction. But it is equally open for the believer in attraction to use that rule, and say, "If attraction will produce gravity without power, it is unnecessary to admit that power is required."

Consequently, as attraction is in possession, it is my duty to establish the fact that natural gravity is produced by mechanical power, in a similar way to its production artificially by means of the nozzle. To do that we must first analyze the mechanical action in the nozzle experiment.

I will not attempt an explanation of that action by the Newtonian laws of motion, because they are inadequate for a true dynamical explanation, and it would be a waste of time to make the attempt. Some of the brightest mathematical geniuses have been trying during two centuries to reconcile the two, and they are still an immeasurable distance apart, as will be seen in the mathematical theory of the gyroscope, or spinning top, which can only be solved when spinning under constraint; but for perfectly free motion there can be no solution given by the present laws of motion, which is self-evident when the parallelogram of forces given a straight line resultant. But as I can prove that the true resultant in compounding momenta transversely is a curve, and that the parallelogram of forces under such conditions is a mistake, that will simplify the solution.

Consequently it is better for me to prove that Newton's laws of motion are inadequate, and by experiment show what the true laws of motion should be, than to keep circling in the old course, which is already strewn with the whitened bones of great philosophers who were immeasurably better qualified to find it (if it is possible to find it there), than I am. Therefore, I prefer to take a new departure, not for the sake of change, but for the sake of success. The fundamental principles on which Newton's second law is based are Galileo's principle of inertia, and the independent superposition of momenta.

I find that under certain conditions these principles are quite correct, but I also find that these conditions are entirely artificial; and, consequently, in applied mechanics, Newton's law is available; but it is not available under natural conditions. Newton himself knew that they could only be used in the explanation of natural phenomenon by the addition of the law of attraction—a law which entirely subverts his first law of motion, because it makes bodies move of themselves; or in the language of Karl Pearson, they have a "mutual regard for each other," and become dancing partners, with a selective capacity depending on quantity of mass, and distance apart. And it is that fallacy which has done so much to lead shallow minds into accepting the theory that matter is the God of the universe. As the great La Place told the great Bonaparte, it was all the Creator that was necessary.

Let us consider first Galileo's principle of inertia, to ascertain under what conditions it is true, and where it is false. Galileo's law of inertia: (See Kelvin & Tait's Nat. Phil., § 254.)

"When any forces whatever act on a body, then, whether the body be originally at rest or moving with any velocity and in any direction, each force produces in the body the exact change of motion

which it would have produced if it had acted singly on the body originally at rest."

The same is expressed more tersely by Kelvin & Tait in § 253:

"Thus the same force will produce precisely the same change of motion in a body, whether the body be at rest or in motion with any velocity whatever."

For a still more detailed statement, see Price, Inf. Cal., Vol. III, §§ 246-7.

That law only applies when the force is acting in the direction of the bodies' previous motion, where change of direction does not take place. Now constant acceleration in a straight line never happens naturally, unless we suppose with Newton that matter has the innate power of attraction, or moving of itself. If a locomotive start a train and keep accelerating it at the rate of one foot per second for ten seconds, the acquired velocity will be ten feet per second. And the law says that during the eleventh second the same force will produce an increase of one foot per second, as was required to start the body from rest if the train has mass only, and is moving in free space. So far the law is correct.

But if the train was constantly moving in a circle, the law would not then hold, because the law of the force which changes the direction of motion is $M V^2/r$, which shows that resistance to change of direction increases with the velocity when the mass is constant; or more generally. *Resistance to change of direction in a circle is directly as the momentum, and inversely as the radius of the circle.* But according to Galileo's law it does not matter what the direction is, or what the velocity may be, the resistance to change does not vary so long as the rate of change does not vary.

Now that is a self-evident blunder, as any engineer who is responsible for the construction of a railway knows; and if he was to use that law in his practice, as natural philosophers and astronomers do, he would be either imprisoned for manslaughter or lynched by a mob on account of the terrible destruction to life and property at every curve in the railroad. He learns to cant his curves to meet increase of speed as well as curvature.

It is well for astronomers that they are not responsible for laying out a planet's orbit according to that law, or it would take more than all the hemp of Manilla to keep the world in ropes.

The crucial proof of the fallacy of that part of the law depends on experiment, and I will close this article by giving one of the simplest and most direct experiments of which I know.

EXPERIMENT II.

The following sketch will show my arrangement for proving that the resistance to change of direction of momentum increases with

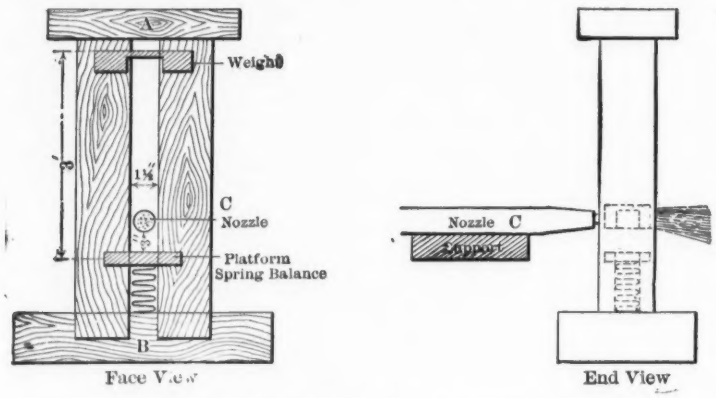


DIAGRAM OF EXPERIMENTAL APPARATUS.

the momentum, so that those who are not satisfied with the physical reasoning based on the whirling table, where $F = M \vee^2 /r$ is the law of force, instead of $F = M/r$, as Galileo's law calls for, may test the matter for themselves.

Fix a straight water nozzle, *C*, one inch in diameter, in a horizontal position, and have an arrangement by which uniform jets of water can be forced through the nozzle at velocities from 5 ft. per second, to 10, 20, 40, 80 and 100 ft. per second. If an adjustable nozzle can be had that will keep the mass constant at these velocities, very well; but if not, then the increase of mass must be calculated in the experiment. Erect a small frame, *A B*, with slots for a weight to slide in similar to that used by pile drivers, but only large enough to give a clear fall for the weight of 3 ft. above the platform balance, which is placed about 3 in. below the nozzle. Have the frame fixed vertically so that the weight in falling will cut through the water jet at the point of the nozzle (without striking the nozzle) and then give an impact to the spring balance underneath the jet.

The balance should have an indicator, and be so arranged that the full amount of the impact will be registered, and can be recorded after every impact at the different velocities of jet above mentioned, the height of drop being constant. The most of the weight should be in the slots, so that the thin portion which cuts through the jet would not impede the jet when it was passing the point of the nozzle; but the portion of the weight which strikes the jet should be rigid enough not to yield to the water at the instant of impact.

The experiment proves that the registered impact is reduced in proportion to the momentum of water jet, whereas, if Galileo's law were correct, the momentum of the jet would have no effect in reducing the impact. Because it says that the same force will produce exactly the same effect whether the water be at rest or moving with any velocity whatever and in any direction.

That is the orthodox law in compounding momenta, and on that law Newton based his whole system. And if we acknowledge that the law is wrong in change of direction, then we must acknowledge that the law of the parallelogram of momenta is also wrong.

Completion of the First American Pacific Cable.

A great electrical project, long under discussion in various ways, has just been brought to a successful close by the completion of the Commercial Pacific Cable, when President Roosevelt sent a message to Governor Taft at Manila. The earlier stages in this great work have been duly noted by this journal, and a map is now presented with this article, prepared by the Commercial Pacific Cable Company, showing the route from San Francisco to the Far East, the distance in nautical miles from the Golden Gate to Manila being 8,198 miles. As a matter of fact, one more link remains to be laid down, namely the cable from Manila to Shanghai and Hong Kong, constituting an all-American cable from one Pacific continental shore to the other, and interlacing with the existing network that envelopes the coast of the Chinese Empire, Japan and the Strait Settlements, as well as the British colonies and possessions.

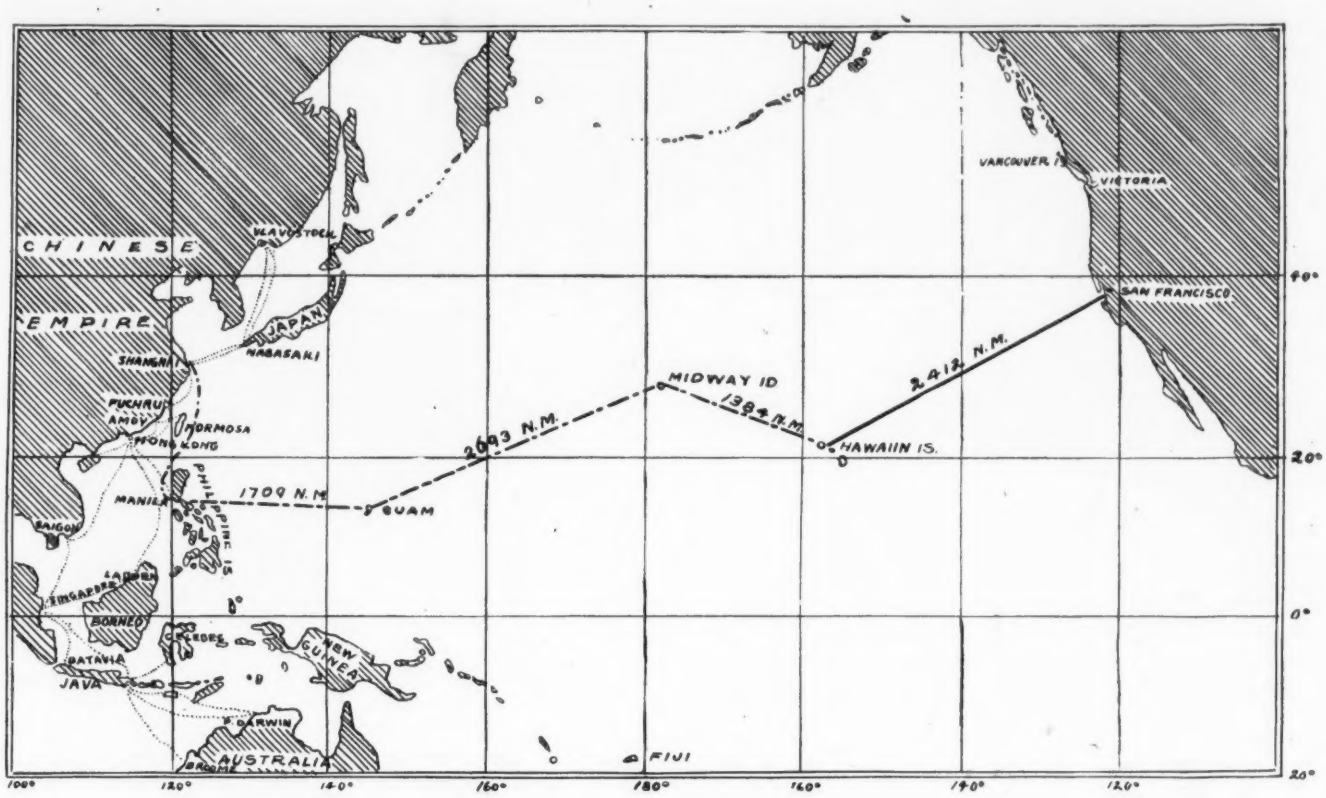
A great many interesting features have attended this work—political, financial, electrical, geographical and commercial. The extreme depth of the Pacific interposed many unusual difficulties. The route has four great ocean stretches of 2,270, 1,254, 2,593 and 1,490 miles. Between San Francisco and Hawaii, the mean depth is 2,500 fathoms, with a maximum of 3,073; between Hawaii and Midway Island, the mean depth is 2,000, the maximum 3,026; from Midway Island to Guam, the mean depth is 2,600, with a maximum of 4,900, and with sudden and great fluctuations; from Guam to Luzon, the average depth is 2,200, the maximum 3,400 fathoms. In 2,900 fathoms, with the ship steaming at 8 knots an hour, no less than 25 miles of cable are in suspension in the water. Two and a half hours are occupied in such case by any particular point in the cable from the time of leaving the ship to touching the bottom. Midway Island referred to above and noted on the map, is virtually a new American colony, created by the Commercial Company, and consists of two small islands surrounded by a coral reef eighteen miles in circumference. Buildings have been erected for the cable staff, the colony has been put under the care of the United States Navy Department, and Lieutenant-Commander Hugh Rodman has been appointed first governor.

The cable itself has been made and laid with great care, the contractors being the India Rubber & Gutta Percha Telegraph Works Company of England, and the work being begun by the cable steamer "Silvertown," which left the Thames with the first section, 2,413 nautical miles, on September 23, 1902. The cable proper, of copper, is sheathed in gutta percha. To protect these two, known technically as the core, brass sheathing is used. Next comes a cushion of jute yarn, and outside of all an armor of iron and steel wires. In the construction of the cable, which is 8,300 nautical, or nearly 9,600 land miles, in length, the following materials have been used: Nineteen million pounds of iron and steel wires, 2,010,000 pounds of jute yarn, 306,000,000 yards of preservative tape, weighing 5,090,000 pounds; 52,000 pounds of brass sheathing, 3,600,000, pounds of copper, 2,310,000 pounds of gutta percha, and 4,220,000 pounds of preservative compounds. The whole work has been completed in eighteen months from the date of the signing of the contract. A separate contract was awarded to the Telegraph Construction and Maintenance Company to lay the sections of the cable from Hono-

lulu to Midway-Guam and the Philippines. On the 9th and 10th of April last the steamships Colonia and Anglia, belonging to the manufacturers, left London with more than 6,000 miles of cable in their tanks. The Colonia, which laid the longest section, that between Guam and Midway, 2,606 nautical miles, is the largest cable ship afloat.

The political and international fight over this cable has been long, and its close was hastened by the Spanish war and the acquisition of the Philippines, at which time the United States Government alone found itself to be paying out at least $400,000 for messages to and from the new possessions. Between September 20, 1895, and December 14, 1896, no fewer than twelve bills were introduced in the United States Senate and the House relating to the construction of a cable across the Pacific. Bills were reported and passed in one House, only to fail in the other. In the winter of 1901 Mr. John W. Mackay offered to lay the cable without subsidy or guarantee of any kind, as a private business enterprise. The bill favoring Government ownership finally came to a vote, and was rejected by 116 to 77. Meanwhile, the Commercial Pacific Cable Company was incorporated under the laws of the State of New York on September 23, 1901, with a charter authorizing it to lay and operate a submarine cable from California to the Philippine Islands, by way of the Hawaiian Islands. Prior to its incorporation the rate for messages from New York to the Philippine Islands was $2.35 a word; in November, 1901, this rate was reduced by the European cable companies to $1.66 a word. The mere announcement of the intention of the Commercial Company to lay a Pacific cable thus effected a saving of 69 cents a word. Before entering on the execution of its contract the Commercial Company bound itself to charge only $1 a word from San Francisco to China; $1 a word from San Francisco to Manila, and 50 cents from San Francisco to Honolulu, the last named rate to be reduced within two years to 35 cents a word. The company in its contract signed with President Roosevelt also agreed further to ask no exclusive concession, to operate independently of foreign companies, to be entirely at the service of the country in time of war, and to employ only Americans.

On July 4, as noted above, the circuits were completed and the first messages were flashed, the time occupied in the circle around the world being stated as 12 and 14 minutes for the 25,835 miles, with 20 transmitting and receiving stations. The President's message was as follows:



MAP OF ROUTE OF AMERICAN PACIFIC CABLE.

the President and was addressed to Clarence Mackay at Oyster Bay. Mr. Mackay was in the telegraph office there and watched the sending of the message, which was to come back to him after circling the earth, it was hoped within an hour. This was the message:

Congratulations and success to the Pacific cable, which the genius of your lamented father and your own enterprise have made possible. THEODORE ROOSEVELT.

President Roosevelt's message to Governor Taft at Manila and the latter's answer were also successfully flashed under the waters of the Pacific, as well as the congratulatory words from Mr. Roosevelt to the president of the Commercial Cable Company, Mr. Clarence H. Mackay, which was sent completely around the world.

Mr. Mackay announced the official time for the President's message going from east to west as twelve minutes. It left Oyster Bay at 11.21 and returned at 11.33. Mr. Mackay addressed a reply as follows to the President:

OYSTER BAY, July 4.

To the President:

I thank you deeply for your message and I earnestly hope the

GOVERNOR TAFT, MANILA: OYSTER BAY, N. Y., July 4.

I open the American-Pacific cable with greetings to you and the people of the Philippines. THEODORE ROOSEVELT.

This was Governor Taft's reply, sent from Manila over the new cable:

The Philippine people and the Americans resident in the islands are glad to present their respectful greetings and congratulations to the President of the United States, conveyed over the cable with which American enterprise has girdled the Pacific, thereby rendering greatly easier and more frequent communication between the two countries. It will presently lead to closer union and a better mutual understanding of each other's aims and sympathies, and of their common interest in the prosperity of the Philippines and the education and development of the Filipinos.

It is not inappropriate to incorporate in this the first message across the Pacific from the Philippines to America an earnest plea for the reduction of the tariff on Philippine products, in accordance with the broad and liberal spirit which the American people desire to manifest toward the Filipinos, and of which you have been an earnest exponent. TAFT.

Not long after the President's message had been sent, another message was started, this one to go around the globe. It was from

Pacific cable, by opening the wide horizon of the great East, may prove a useful factor to the commerce of the United States.

CLARENCE H. MACKAY.

This message was sent eastward, going over the old European route to Manila and back by way of the new Pacific cable to San Francisco. It started at 11.55 o'clock and at 12.04 it came ticking back again—just nine minutes being consumed in its journey around the world.

A number of other messages with the Philippines and Governor Taft were exchanged by ex-President Cleveland, Secretary of War Elihu Root, General Miles, Mayor Low, Archbishop Ireland and others. All the officials of the Commercial and Postal Telegraph companies participated actively in the memorable exercises.

Recent Electrochemical Developments.

RECTIFYING ALTERNATING CURRENTS.

It has long been known that an aluminum electrode allows an electric current to pass, when it is used as cathode, while it interposes a very high resistance, when used as anode. For this reason the aluminum electrode has been called an "electrolytic valve" and various inventors have endeavored to utilize it for converting alternating into direct current, the differences between the various schemes consisting mainly in the use of different aqueous solutions as electrolyte and in details of the arrangement of the apparatus. The German storage battery manufacturing firm of Pollak experimented with such electrolytic rectifiers for a period of several years and used them for charging batteries from the Frankfort alternating-current mains. These experiments were, however, discontinued, for reasons not exactly known. More recently Mr. Nodon, a Frenchman, has placed an electrolytic rectifier, with an aqueous solution as electrolyte, on the market, but it is still too early to say anything concerning its commercial success.

In all these former experiments, aqueous solutions were used which have serious disadvantages. The principal defect is that there are considerable current losses, causing the development of heat in the cell. If the temperature is permitted to rise indefinitely, the efficiency of the cell is greatly diminished and the cell may be destroyed. In a patent for an "asymmetric conductor," granted on June 30 to Mr. Carl Hambuechen, of Madison, Wis., it is claimed that these disadvantages may be eliminated or greatly reduced by the use of a fused electrolyte, as for instance the nitrates, hydroxides, chlorates and bichromates of the alkali metals. These materials are at ordinary temperature non-conductive and must be preheated when operation is to be started. When the temperature has been raised sufficiently, the special heating device may be disconnected, as the heat due to the current is sufficient to hold the electrolyte in a molten or conductive condition.

It will be remembered that in a paper presented before the American Electrochemical Society by the inventor jointly with Prof. C. F. Burgess (ELECTRICAL WORLD AND ENGINEER, Vol. 39, p. 651), a number of data were given which appear to substantiate the claims made for the apparatus. If it proves to work as well on a commercial scale as it is said to have worked in the laboratory, it should be very useful for many purposes, even although there may result some competition between the electrolytic rectifier and the Cooper Hewitt static converter which serves the same purpose.

APPLYING HEAT TO ELECTROLYTES.

A patent has been granted to Prof. C. F. Burgess and Mr. Carl Hambuechen, of Madison, Wis., for an electric method of heating an electrolyte, by passing through it a low voltage alternating current, this heating circuit being distinct from the electrolyzing circuit. If for instance it is desired to heat the electrolyte in the neighborhood of the anode, the low voltage alternating current is passed through the anode and an auxiliary electrode. This method seems to have been devised by the inventors for use in connection with their electrolytic rectifier, but has of course a wider application.

SILICON AND ALUMINUM FROM SILICATES OF ALUMINA.

A patent granted on June 30 to C. H. Homan, of Christiania, Norway, is another example of the use of aluminum as a reducing agent in metallurgy, which has already found various applications. The inventor proposes to treat materials containing silicates of alumina—for instance, common clay—in the following manner: The clay is heated in an electric furnace at a temperature of about 4,500° F., with aluminum as a reducing agent in such quantity that the silicic acid and certain bases—for instance, ferric oxide—are reduced, while the oxide of aluminum remains unreduced. The resulting products are silicon, together with the metals of the respective bases, and a slag substantially containing oxide of aluminum. If other silicon products are to be obtained separately—for instance ferrosilicon—the reduced silicon may be tapped out at different stages of the process, so that at one stage of the process pure silicon and at another stage ferrosilicon is obtained. The remaining slag is treated to obtain the aluminum, originally contained in the silicate, as well as the aluminum which had been used as reducing agent.

PURIFYING WATER BY ELECTROLYSIS.

In a patent, granted on June 30, to Mr. W. R. Chipman, of New York City, the inventor describes an anode for electrolytically purifying liquids. Its effect consists, according to the inventor, in the production of oxyhydrates which form with the nitrogenous matters in solution or in suspension a coagulum which is easily filtered out, leaving the liquid pure. The anode is composed of metallic aluminum as the "oxyhydrate developing element," of Straits tin as the "binding element," and of nickel as the "hardening element." With these elements a suitable flux is used.

Recent Development at Niagara.

The most important news that industrial Niagara has heard in some time, is the statement, recently confirmed by Mr. W. B. Rankine, of the consolidation of the MacPherson Switch and Frog Company, of Niagara Falls, N. Y., with the Ramapo Iron Works, of Hillburn, N. Y. This consolidation means that the works of the company at Niagara Falls will be enlarged very substantially, and a number of skilled operatives employed. A meeting of the new company is to be held early in July, at which time officers are to be elected, and other important preliminary business transacted.

On the Canadian side, a section of one of the five great penstocks which will conduct the water to the turbines in the wheelpit of the Canadian Niagara Falls Power Company's new plant is now in place. The pit is being rapidly completed, and work on the extension will soon begin. The present pit has a capacity for but five turbines, while the extension will hold six. A portion of the stone arch bridge over the intake canal has been erected, and is very beautiful. The concrete foundations of some portions of the power house are being laid, and before long the handsome stone edifice will begin to rise. Every part of the work is progressing in a manner highly satisfactory, both to the contractors and the power company.

The temporary power house constructed at the Dufferin Islands by the Ontario Power Company to furnish power for the construction of their works, was put in operation June 25.

The construction of the great dam of the Toronto and Niagara Power Company out into the rapids of the Niagara is being pushed forward, in spite of the great natural difficulties. The swiftness and dash of the rapids caused one of the great cribs to snap its retaining cables several days ago, and it now lies, a complete wreck, on a reef of rock farther down the river. Some seventy-five feet are to be added to the dam in its present direction, after which the structure will be continued down stream and toward the shore.

All Space Full of "Juice."

Advices from Denver, Colo., state that a representative of the Whitney Electric Development Co. is there to arrange for transporting a 13-in. cannon to the summit of Pike's Peak or some lofty pass in the mountains to prove the theory of Mr. Whitney, of Chicago, that by penetrating the atmosphere surrounding the earth he can secure from the electrical sea above unlimited current for earthly power plants. Mr. Whitney, when he secures and locates his monster gun, will fire a spherical iron magnet vertically. To this projectile will be attached a coil of wire twenty or thirty miles in length. Mr. Whitney believes that, once beyond the pale of the law of gravitation, the magnet will be drawn into the electric sea, the wire will hold it and by attaching larger wires he can draw from above limitless electric power. It will be a great pity if this theory is not allowed to demonstrate its insanity—or its soundness.

Telephone Exchanges.--VI.

BY ARTHUR V. ABBOTT, C. E.

PERMANENT MAGNETS.

THERE are three properties desirable in material for permanent magnets. First, to minimize bulk, the material should have a high permeability in order that it may accept a large amount of magnetism. Second, after magnetization the material should retain as large a proportion of the flux created as possible. The quality of magnetic *retentiveness,* or the ability of a substance to retain and keep the flux impressed upon it, is termed *remanence.* Third, the remanence should be *permanent;* that is, the magnetic state should not gradually change and decay, but should always remain, otherwise the usefulness of the mechanism will sooner or later fail. The ability of any substance to retain permanently magnetism impressed upon it, may be measured by the amount of *demagnetizing force,* which has to be applied, in order to return it to the neutral condition. Thus the specimen from which the curve of Fig. 15 were plotted required a negative magnetomotive force of 40 to cause its magnetism to disappear, while for the one shown in Fig. 16 only 1.9 gausses were expended. The first sample would be said to be about twenty times as permanent as the second. The amount of negative magnetomotive force that must be expended to cause a body to return to neutrality after having been magnetized is termed *"coercive force,"* and such diagrams as are exemplified in Figs. 15 and 16 are valuable means of estimating magnetic characteristics.

For any specimen of magnetic material the *remanence* is shown by the induction or value of B on the vertical scale, when the value of H is reduced to zero on the return path from a much greater mag-

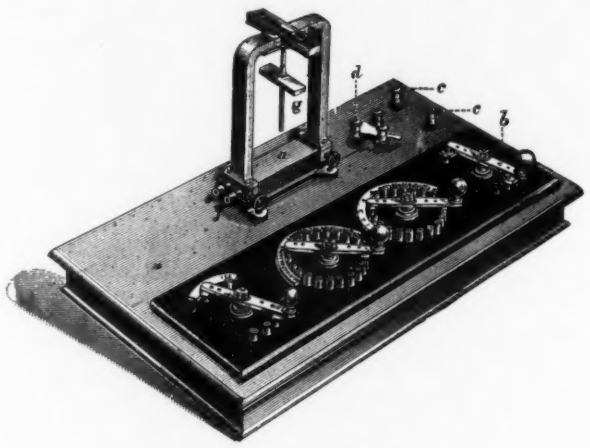


FIG. 17.—PERMEABILITY BRIDGE.

netization. The coercive force is measured by the amount of negative magnetomotive force that must be applied to destroy the remanence. Thus in Fig. 19 for the specimen marked 1,294 *L* the remanence is 9,100 and the coercive force 14. There is no means of predicting *a priori* the magnetic characters of any sample of iron or steel, and so much depends on chemical and physical qualities that are at present very obscure that different lots made by the same manufacturer by identical processes will vary widely from a magnetic standpoint. The only sure way is to test a sample of each lot purchased and plot for each test piece a characteristic curve.

Fortunately apparatus can now be found on the market with which the $\mathfrak{B} - \mathfrak{H}$ curve of any sample can be plotted as easily as the resistance of a relay spool can be measured with a Wheatstone bridge. In fact, Ewing's permeability bridge, shown in Fig. 17, performs exactly the office for reluctance that Wheatstone's does for resistance. The operation is as follows: The vertical U bar, *g,* on the rear of the baseboard carries a compass needle. At the base of this U are two holes, *e* and *f,* into one of which a standard piece of iron or steel is placed, whose $\mathfrak{B} - \mathfrak{H}$ curve is carefully determined. This corresponds to a standard resistance coil. Alongside of this standard is placed the bar to be tested. Magnetizing coils are provided in the base of the apparatus controllable by the sliding contacts of the switch handle seen in front. Now, if the magnetic condition of the standard bar and the test bar are exactly the same no effect is produced on the needle on the top of the yoke, but if they are not the same, the needle deflects an dthe magnetizing effect of the coils is altered till the needle comes to zero exactly as in a Wheatstone bridge the pegs are moved till the galvanometer reads zero. To measure hysteresis the same inventor has produced the apparatus shown in Fig. 18. The sample to be measured is clamped on the

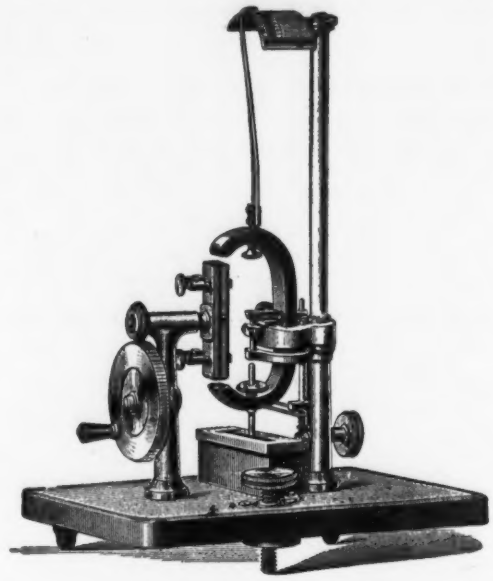


FIG. 18.—HYSTERESIS METER.

spindle that can be rapidly rotated by the gear and crank. It is then set in motion and whirled between the poles of a suspended magnet. This magnet is supplied with a long pointer moving over a graduated arc on the top of a column to which the magnet hangs, and the hysteresis is measured by the deflecture of the needle. With such facilities at command there is little excuse for any manufacturer who fails either to provide the best magnetic materials or maintain a uniform standard.

From time to time many investigations of the magnetic qualities of various irons and steels have been made. The chief early workers in this field were Ewing and Hopkinson, from whose researches, as well as from various other sources, the general data of Table I is

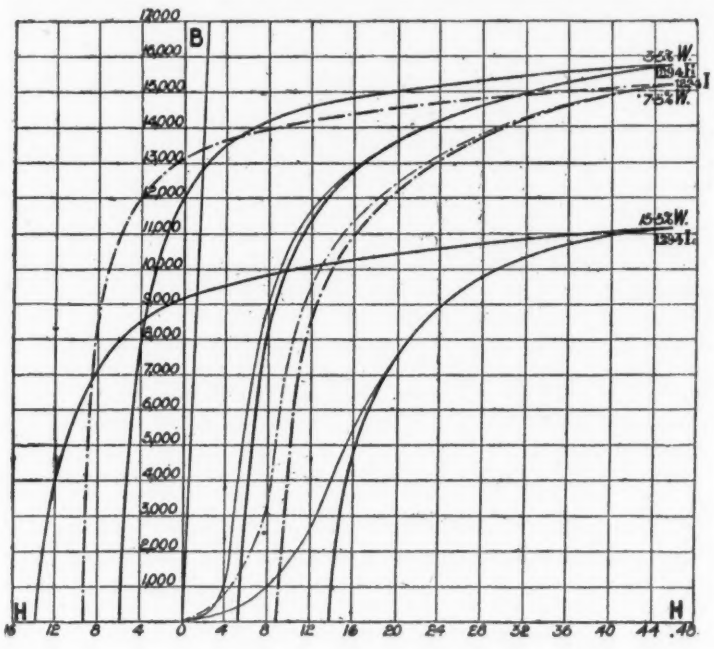


FIG. 19.—CURVES FOR TUNGSTEN STEEL.

compiled. But it must be remembered that while such information is of value as a general guide it can by no means supplant the necessity for each maker to watch and test the particular brands he employs; as well expect an engineer to built a bridge on general principles, without exacting tests of the particular channels, eye beams and eye bars that he uses.

Recently Messrs. Barrett, Brown & Hatfield have made a very extended investigation upon the magnetic properties of the more modern steels and irons, the results of which have appeared in a paper before

the Institution of Electrical Engineers.* A portion of the results obtained by these investigators that are of particular value to telephonists as showing that some peculiar alloys of iron would seem to be specially adapted to the magnetic system of receivers.

TABLE I.

REMANENCE AND COERCIVE FORCE OF VARIOUS SAMPLES OF STEEL.

Kind of steel and observer.	Max. H applied.	Max. B attained.	Residual B	Coercive force.
Ewing.				
Steel wire, hard drawn	57	14,300	8,200	16
Steel wire, annealed	53	14,600	11,700	17.5
Steel wire, glass-hard	55	9,400	6,800	39
Piano forte steel wire, normal temper	92	14,600	11,800	27
Piano forte steel wire annealed	94	14,300	10,500	24
Piano forte steel wire glass-hard	98	12,700	9,600	41
Cast iron	16	3,700	2,600	8
Very soft iron wire	17	13,500	11,000	1.9
Annealed wrought iron	90	16,200	12,700	3
Whitworth mild steel, annealed	250	16,120	10,740	8.3
Hopkinson.				
Whitworth mild steel, oil hardened	250	16,120	8,736	19.4
Chrome steel, as forged	250	14,680	7,568	18.4
Chrome steel, annealed	250	13,233	6,489	15.4
Chrome steel, oil-hardened	250	12,868	7,891	40.8
Tungsten steel, as forged	250	15,718	10,144	15.7
Tungsten steel, annealed	250	16,498	11,008	15.3
Tungsten steel, hardened tepid water	250	15,610	9,482	30.1
Tungsten steel, (French) oil-hardened	250	14,480	8,663	47.1
Tungsten steel, very hard	250	12,133	6,818	51.2
Weber, common steel magnet			3,947	
Von Waltenhofen tungsten steel, glass-hard			4,638	
Perry, Jowitt's steel			12,600	
Preece, Wall's steel			1,519	
Preece, Ashford's steel			1,704	
Preece, Saunderson's steel			1,435	
Preece, Jowitt's steel			1,435	
Preece, Vicker's steel			1,174	
Preece, Crewe "rivet steel"			186.6	
Preece, Crewe "spring steel"			1,391	
Preece, Clemandot steel (compressed and tempered)			2,264	
Preece, Clemandot steel (compressed but untempered)			1,333	
Preece, Marchal steel			2,540	
Preece, Allevard steel (mercury-hardened)			1,315	
Preece, Allevard steel (water-hardened)			1,660	
Gray, magnet steel, glass-hard			6,536	
Evershed, Wall's and Jowitt's steels (mean)			4,000 to 5,000	
Brown, magnet steel, glass-hard			6,000 to 7,000	

The data exhibited in these tables show there is a wide variation in the properties of the various steels obtainable for permanent magnets. In Table II the steels that appear the most valuable to the telephonist are those containing manganese, nickel and tungsten, and to exhibit the properties of these steels more completely Figs. 19, 20 and 21 give the hysteretic curves for the various samples referred to in Table II. From these curves it is easy to pick out by inspection four samples that are seemingly the best suited to the manufacture of permanent magnets. The relative qualities of these specimens are shown in Table III.

In selecting a steel for a permanent magnet two somewhat opposing qualities must be balanced. A high permeability and, in general, relatively great remanence is usually coupled with a low coercive force. Hence while such steels exhibit the ability to develop (temporarily at least) a large magnetomotive force per unit of volume they are apt to soon decay, and lose the magnetism impressed on them. Magnets made of such material may be of light weight and of small volume. On the other hand, steels which show a high coercive force indicative of great permanence have relatively low remanence because their permeability is small, and it is impossible to make them retain even with the most intense fields more than 5,000 to 8,000 gausses. Magnets made of such steels, while exhibiting great durability, can only emit a relatively feeble magnetomotive force per unit of volume, so such magnets must be large in volume and correspondingly heavy. On the whole for telephone receivers great coercive force is to be preferred, but the quality of remanence must not be entirely ignored or the magnet will become too bulky. Of the specimens in Table III, sample No. 3 showed the highest coercive force, but the remanence is very low. While such a steel would be "permanent" its power of producing magnetomotive force would be small, necessitating a large and heavy magnet to secure the requisite flux. Sample No. 4 shows very great remanence, and excellent coercive force. Such a steel would be better suited to receiver magnet manufacture than any of the others.

TABLE II.—MAGNETIC PROPERTIES OF IRON ALLOYS.

Group.	Mark.	Percentage of main element alloyed with iron.	Maximum induction for H = 45.	Permeability μ for H = 8.	Remanence in terms of B.	Coercive force in terms of H.	Energy dissipated per complete cycle. Ergs. per c. c.
Carbon steels ..	B	0.03C.	16,800	1,625	9,770	1.66	10,760
	LSS	0.05C.	15,720	1,500	9,090	1.66	11,300
	611	0.58C.	15,610	1,035	10,370	2.56	22,200
	613	1.00C.	14,000	654	9,000	6.43	32,750
	614	1.25C.	14,000	375	9,040	6.43	33,330
Manganese steels	48	0.50Mn.	16,000	1,165	10,000	3.20	19,650
	4147	1.00Mn.	15,540	1,100	11,320	3.4	22,150
	53	2.25Mn.	14,720	1,080	10,460	6.0	30,580
	39	4.00Mn.	9,370	125	5,950	16.2	39,500
	34	4.75Mn.	8,320	73	5,420	19.6	39,400
	945A	7.00Mn.	3,820	23	2,230	20.0	19,650
Nickel steels ..	1287D	1.92Ni.	16,000	1,380	9,140	2.67	15,300
	1287E	3.82Ni.	16,190	1,375	9,320	2.76	15,860
	1267B	4.75Ni.	10,500	125	6,910	14.28	39,800
	1287I	11.39Ni.	8,190	118	4,630	17.33	32,050
	1447B	12.10Ni.	4,170	....	4,500	22.40	21,850
	1447A	12.70Ni.	4,480	....	3,900	22.10	24,280
	1287K	19.64Ni.	7,770	90	4,770	20.00	36,850
	1287L	24.50Ni.	4,230	32	2,790	22.50	22,200
	1449	31.40Ni.	4,460	357	1,720	0.50	803
Tungsten steels.	1294F	1.0 W.	16,000	1,400	10,000	3.23	14,150
	1294H	3.5 W.	15,720	1,280	12,720	5.73	25,050
	1294I	7.5 W.	15,230	500	13,280	9.02	47,500
[illegible]	1294L	15.5 W.	11,090	125	9,320	13.92	44,000
Aluminum steels	1167D	0.75Al.	16,000	1,500	10,500	1.80	11,000
	1167H	2.25Al.	16,900	1,700	10,500	1.00	8,000
	1167I	5.50Al.	13,000	1,200	4,150	1.00	6,500
Silicon steels ..	898E	2.5	16,420	1,680	4,080	0.90	7,900
	898H	5.5	15,980	1,630	3,439	0.85	6,500
Coper steels ...	1264A	1.59	14,600	....	10,520	5.0	....
	1264B	2.5	14,300	....	10,410	5.4	....
Chromium-aluminum steels .	1178B	1.74Cr. 0.75Al.	14,490	1,040	10,350	6.0	25,750
	1178D	1.5 Cr. 2.25Al.	13,890	1,180	9,680	3.52	17,550
	1178E	1.5 Cr. 4.5 Al.	13,150	1,060	8,560	1.77	13,420
	1179B	3.5 Cr. 1.0 Al.	13,540	466	9,550	8.0	34,700
Chromium-Nickel steels.	1286A	0.75Cr. 2.75Ni.	16,480	1,210	7,730	3.0	....
	1286C	1.75Cr. 2.5 Ni.	15,150	485	11,110	7.9	....
	1210D	4.5 Cr. 2.5 Ni.	13,650	....	9,800	13.1	....
Manganese-nickel steel ..	1254C	3.75Mn. 4.0 Ni.	6,410	121	3,770	19.6	....
Silicon-nickel steels	1103A	2.0 Si. 3.25Ni.	15,750	1,085	6,780	2.0	....
	1103C	3.25Si. 3.5 Ni.	15,480	1,240	7,050	1.9	....
Tungsten-cr. steel	1189B	2.0 W. 0.75Cr.	15,950	1,125	12,150	5.3	....
Tungsten-mn. steel	687	3.25W. 2.35Mn.	15,250	815	12,080	6.5	....

Not only does the permanent magnet depend for its success upon the kind of material from which it is manufactured, but as much is involved in the treatment which the metal receives at the hands of the smith in forging and tempering. A general impression exists that the harder the temper, the better the magnet will be; but like many other current ideas this is fallacious. It is more a question of careful working and *judicious* tempering, than the attainment of great hardness; furthermore, the temper to be given depends somewhat upon the shape of the magnet, for experiment has shown that short magnets should receive a harder temper than long ones. It is eminently desirable that all heating and forging should be done in a muffle with the greatest care; hammering should be avoided as much as possible and forming done in a die with a press, for a careless smith may irretrievably injure the very best steel.

TABLE III.

	Kind of steel.	Remanence.	Coercive force.
1	Manganese, 4%Mn	66%	66%
2	Nickel, 11.4%Ni	56%	75%
3	Nickel, 24.5%Ni	26%	100%
4	Tungsten, 15.5%Tn	100%	58%

There are two methods of hardening steel; one involves heating and suddenly cooling by plunging in water, oil or mercury, and the other by subjecting to the metal great pressure while in a molten

* See *Journal of the Institution of Electrical Engineers*, Vol. xxi, No. 156.

or semi-molten condition. There is no doubt but that the latter gives by far the most satisfactory results, but this process requires an elaborate and expensive plant. The aim in tempering should be to secure as fine, uniform and homogeneous a grain in the finished bar as possible. Each manufacturer has some pet method to attain this result, but all of these dodges, and the various nostrums which are advocated as tempering baths probably possess but little actual influence upon the final physical condition of the steel, but have considerable influence psychologically upon the man who is making the magnets, and inspires him with confidence and care in their manufacture.

It has been observed that the desirable degree of hardness for permanent magnets depends somewhat upon the size of the magnet, or rather upon the relation of its length to its diameter. No absolutely conclusive experiments have been made to determine the precise connection that exists between hardness and the ratio to length of diameter, but in a general way it is understood that short magnets should be harder than long ones.

Some experiments of Stonhal & Barus, while not final evidence of the dependence of permanent magnets upon hardness, and of hardness to shape of magnet are indicative of the relations which exist between these quantities.

TABLE IV.
RELATIVE MAGNETIC PROPERTIES OF STEELS CONTAINING MANGANESE, NICKEL AND TUNGSTEN.

Designation.	Relative hardness in per cent. glass-hard = 100.	Relative length to diameter. 10 — % Magnetization.	20 — % Magnetization.	30 — % Magnetization.	40 — % Magnetization.	50 — % Magnetization.
Glass-hard	100.0	100.0	87.5	65.0	54.5	50.5
Annealed 1 hr. in steam	88.0	94.0	84.0	62.0	52.0	48.5
Annealed 3 hrs. in steam	83.5	94.0	82.0	61.0	51.0	47.5
Annealed 6 hrs. in steam	80.0	94.0	82.0	61.0	51.0	47.5
Annealed 10 hrs. in steam	78.0	94.0	82.0	61.0	51.0	47.5
20 min. at 185 centigrade	66.0	85.0	82.0	63.5	54.0	51.0
1 hr. at 185 centigrade	63.0	86.0	90.0	66.	56.5	54.0
3 hrs. at 185 centigrade	58.0	87.0	92.0	71.5	61.5	58.0
7 hrs. at 185 centigrade	55.0	88.0	97.0	78.0	67.5	64.0
13 hrs. at 185 centigrade	52.5	84.0	98.5	80.0	69.0	69.0
10 min. at 240 centigrade	50.5	82.0	100.0	83.0	76.5	72.0
1 hr. at 330 centigrade	43.5	76.5	100.0	93.5	88.5	87.0
1 hr. at 420 centigrade	37.0	58.0	88.0	100.0	100.0	100.0
Annealed	34.0	16.0	21.0	25.0	31.0	40.0

According to our present notions each molecule of a magnetic substance is surrounded by the same sort of a stream of ether as that

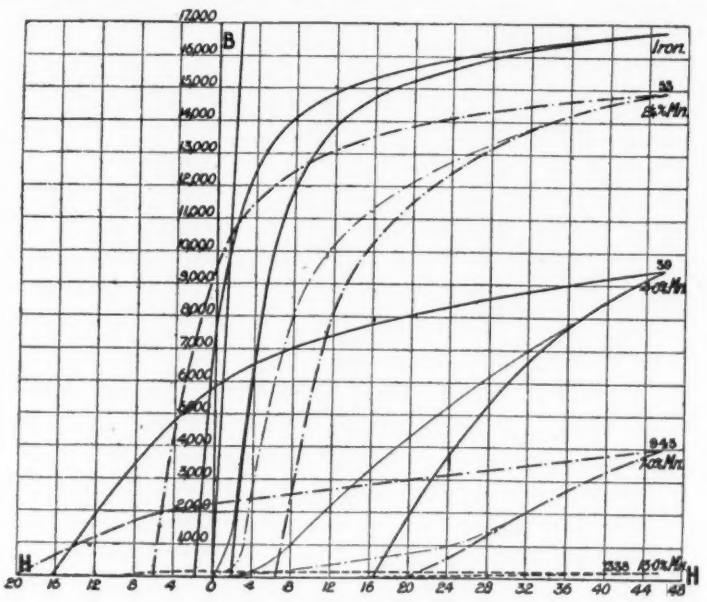


FIG. 20.—CURVES FOR MANGANESE STEEL.

which we imagine issuing from and returning to the poles of an ordinary bar magnet. In soft iron the molecules are heterogeneously arranged, consequently the ether stream from one particle is neutralized and annulled by those from its neighbors, consequently the entire piece is in a non-magnetic condition. When magnetized all of the particles are turned so that their respective ether currents flow in the same direction and thus the stream from one particle uniting with those of its neighbors gradually increase the flux until it becomes of sufficient volume to impress itself upon our senses. Annealed iron is so soft that it is easy for a slight magnetizing force to pull the molecules in line, and as soon as this force is removed there is so little tenacity that the particles readily drop back in their neutral condition. With hard steel the material possesses so much more resistance that it is difficult to impress magnetism upon

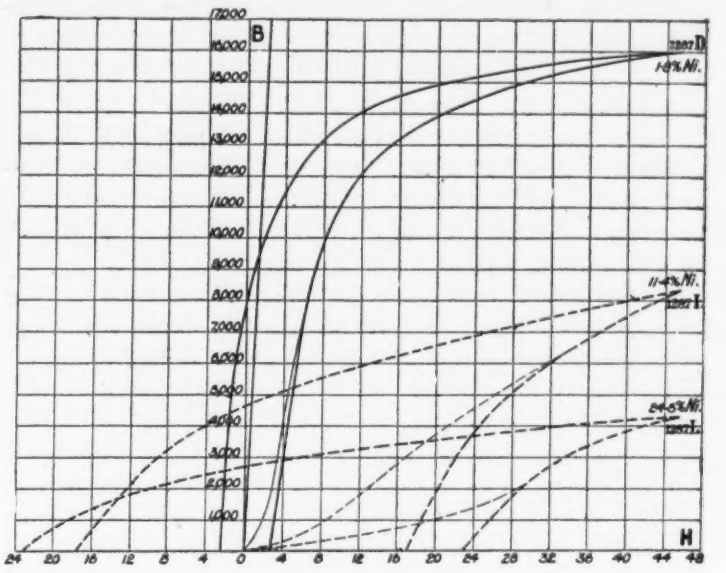


FIG. 21.—CURVES FOR NICKEL STEEL.

it, and a much stronger magnetic force is required to produce a corresponding result. Owing to the greater tenacity of the piece, after it has once been magnetized the molecules are unable to return to their original positions and consequently it retains its magnetism. If this theory be correct anything which tends to disturb the molecular condition will correspondingly operate to injure and destroy permanent magnetism. This is abundantly verified by experiment, for if a piece of soft iron be magnetized it will, if undisturbed, retain a noticeable amount of the impressed magnetism after the magnetomotive force is removed, but if it be jarred in the slightest degree so as to set its particles vibrating, it will immediately lose nearly if not all traces of the magnetic charge. Similarly in the case of a piece of tempered steel, while it exhibits much greater permanency it is nevertheless sensitive to all kinds of shocks, and after magnetization care should be exercised not to pound or jar it.

The tables and curves show that it is possible with some varieties of relatively hard steel to confer a flux of from 10,000 to 14,000 gausses. But such material shows so little coercive force that magnets made therefrom can hardly be called permanent, for even with the utmost pains to avoid vibration, pieces so highly magnetized will by mere lapses of time lose a notable fraction of the charge. Contrariwise other steels which cannot be magnetized more than 4,000 or 6,000 gausses, exhibit sufficient relentiveness to retain all the magnetism imparted for many years in spite of much ill treatment in the way of shocks and blows. To secure permanence, therefore, it is advantageous to artificially age magnets before they are used. After being carefully forged and properly hardened the magnet should be as powerfully magnetized as possible. Almost every maker has a pet method of charging, but all that any can accomplish is to subject the bar to as powerful a magnetic field as possible, and while under the magnetic flux it is well to jar it or pound it in order to bring as many molecules as possible into proper magnetic alignment. After the magnet has been charged it should be allowed to rest quietly for a few days, to allow the molecules to become accustomed to their new positions. Aging should then be performed by *cooking* the magnet; namely, it should be put in a steam bath or boiled at a constant temperature of 212° for some hours or even days. Under this treatment a portion of the magnetism is lost, but that which is retained may be considered highly permanent, for magnets made of the best steel, carefully forged, thoroughly magnetized and subsequently well aged, show almost no magnetic change even after the elapse of several years.

Niagara Meeting of the American Institute of Electrical Engineers.

AS foreshadowed in the notice last week of the opening sessions of the Niagara meeting of the American Institute of Electrical Engineers, the meeting was by far the most successful in the history of the Institute. A high-water mark was reached in attendance, the total of members and guests registered reaching 487. Almost 40 papers were presented, not including a number of written discussions of considerable length, and the discussions were as a rule animated and dealt with the important bearings of the topics considered.

Through the courtesy of the Natural Food Company, the sessions —excepting that of Monday evening—were held in an auditorium in the works of that company, which was excellently suited for the occasion in size, ventilation and acoustic properties. The local committee had made every provision for the social entertainment of the ladies of the gathering and for instruction and pleasure excursions to points of interest in the vicinity of the Falls. An untoward incident of one of these excursions—a night visit to the Gorge—arose from an accident to the railway system, which interrupted the service and held up the party until midnight. A particularly enjoyable feature was the dance on Tuesday evening at the Cataract House.

The usual visits were made to the plants of the Niagara Power Company and Niagara Falls Hydraulic Power & Manufacturing Company, and the members were permitted to inspect a rotary converter at the works of the Pittsburg Reduction Company. A trolley ride was provided over the country wherein the three new Canadian power houses are being constructed.

The excellent address of Prof. Scott is reprinted in part elsewhere. Owing to the number of papers presented and the extent of the discussions, the space available will not admit of the entire programme being covered in this issue. A portion of the report is, therefore, held over for the issue of next week.

ENERGY TRANSFORMATIONS IN THE SYNCHRONOUS CONVERTER.

With this title, Prof. W. S. Franklin presented a paper in which he gave a new method of analysis applicable to the rotary converter. The specific object of the paper was to determine, of the total energy which flows through a synchronous converter, the fractional part which is conductively transferred from supply mains to service mains; and the fractional part which is inductively transferred. The paper is highly mathematical in character and ends with a discussion on "The Criterion of Reality of the Component parts into which a Physical Aggregate is Resolved by Mathematical Analysis."

In the discussion, Dr. Sheldon criticised the division of a current flowing in a conductor into parts, for there never can be but one current and that always in phase with itself. In analyzing the actions in a converter he suggested the use of a series of current time curves piled on top of one another, on abscissa which may be termed time or angular abscissas of the armature coil. The drawing of such curves simply implies the use of a T-square and a templet which corresponds to the shape of the wave. Prof. Sheldon has applied this method to a three-phase converter and derived almost exactly the same results as those found by Prof. Franklin. Prof. Franklin stated that a synchronous converter cannot be looked upon as a synchronous motor in combination with a direct-current generator. As to Dr. Sheldon's graphical method, he stated that it is identically the same as the algebraic method which he submitted, except that the former is applied more easily when the alternating-current curves are not sinusoidal.

COMMERCIAL ALTERNATOR DESIGN.

In a paper with the above title, Mr. W. L. Waters gave an excellent discussion of the various factors entering into alternator design. The discussion was confined to the internal revolving field type, with each pole carrying a separate field coil of edge-on copper strap, the author considering that no other machines compare with this type for general all-around work. Credit is given to C. E. L. Brown and Ferranti for the establishment of this type, the evolution of which was followed up to the present. All the various factors entering into alternator design are discussed in an eminently practical manner, and much information is given for guidance in deciding upon the details of design of machines for various purposes. The matter of power factor is discussed at length, as is also the relation between air-gap and pole density. It was recommended that the regulation be guaranteed for a low power factor and not for a non-inductive load. A tabulation is given of the data of three designs showing how changes in one or more of the details affect the cost of the machine. In conclusion is given a comparison between two machines, one designed in 1894 and the other in 1903, in order to illustrate the great advance that has been made in alternating-current design during that period. The 1894 machine of 50-kw capacity, weighed 7,400 pounds and contained material costing $455. The machine of 1903 is of 275 kw-capacity, weighs 11,000 pounds and contains material costing $490. Those interested in alternating-current machinery aside from their design will find much to interest them in this well-written paper.

Upon concluding his paper, Mr. Waters added that the point upon which he wished to lay stress was that of guaranteeing regulation on a low power factor, which is much better from a designer's point of view, and practically every load that an alternator carries in actual practice is to a certain extent inductive. It is a farce to guarantee regulation for ordinary everyday work at unity power factor, and it is practically impossible to measure regulation on a large machine at unity power factor. It would be a great deal more to the point if the regulation of an alternator was guaranteed at zero power factor, in which case a direct test could be applied, and there would be no need of calculation and making assumptions.

A lengthy communication in the discussion of Mr. Waters' paper was presented by Mr. D. B. Rushmore, in which the problems met in transmission work are considered, including those of insulation and the influence of harmonics. He spoke favorably concerning the inductor type of alternator and went into the subject of star and delta connections, and the relations between armature inductance and reaction and the effect of the latter on field poles. Mr. Ralph D. Mershon disapproved of the use of a temperature rise as low as 30° C., and favored 40 or 45°, which he considered safe with modern insulation. He referred to some alternators he had recently seen in Europe which, though beautiful machines mechanically, were inferior electrically, particularly with respect to power factor and regulation. The European plants that he had seen were also defective in their switching arrangements, no provision of switches being made to break the load in case anything happens. Prof. Harris J. Ryan, on the part of the Committee on Standardization, announced that a change would be made in the Institute rules dealing with the regulation of alternators. Mr. Waters referred to some remarks by Mr. Rushmore, on short circuits, and said that the general practice is, in case of a short circuit, to take either the choice of turning it out or having a circuit-breaker cut-out. An alternator with bad regulation in the case of a short circuit drops its voltage with the result that the operation of synchronous and induction motors is interfered with. An alternator that will stand a short circuit should be a thing of the past. He said that induction alternators can be made with good regulation, but he considered the revolving field alternator superior owing to its much lower cost, the difference being a matter of 30 per cent. He considered that the question of self-induction of the armature of an alternator is one that cannot be discussed theoretically, owing to the great complication of the subject due to the entry of numerous factors. Replying to Mr. Mershon, who had stated that a low temperature rise must be paid for, he said that it is no more trouble to design a machine for low temperature than it is for high temperature. He said that his company was designing machines for low temperature and found it a commercial proposition. While agreeing that in Europe there were some alternators badly designed, he had found that also true in this country, and gave an instance of a plant run by a 300-kw machine, in which the lamps went out when a 75-hp induction motor was started up. Mr. Mershon said that abroad he had seen alternators made by firms of the very highest standing and the impression that he had derived was that the requirements as to regulation were not so severe as in this country.

INSTITUTE BRANCH MEETINGS.

Prof. W. E. Goldsborough read a paper by Mr. Calvin W. Rice, entitled "Institute Branch Meetings, their Organization, Development

and Influence," giving an account of the work of the Institute in this direction during the past year.

In the discussion Prof. Ryan spoke enthusiastically in favor of the development treated by Mr. Rice, and said that at Cornell the work of the local branch is a part of the regular engineering instruction. The plan there is to abstract the papers and present them before members of the senior and junior classes, as well as all the local members of the Institute resident in Ithaca. The papers are abstracted by members of the senior and graduating classes, assisted by the officers of instruction, which work is supplemented by brief analyses of the careers of the men who have been the authors of the papers. When the reports of the discussions come, they are gone over, somewhat abstracted and presented to the students. The students take the greatest interest in the papers, as well as in the discussions, and the results of this movement on the part of the Institute has been productive of excellent results. Prof. Goldsborough also spoke highly of the benefit derived from branch meetings at Purdue University, and also of the plan to enroll students as junior members of the Institute. The Purdue Electrical Society has become the Purdue branch of the American Institute of Electrical Engineers, and during the year the students have met every two weeks. Next year the programme will be to have the first meeting in the month given to local subjects, and the second meeting given to regular Institute business. Prof. Goldsborough said that at St. Louis regular monthly meetings had been held with great success, for which much credit is due to the secretary of that meeting, Mr. Swope. Mr. Peter Junkersfeld, of Chicago, said that the Chicago meeting is the oldest branch of the Institute, and made some suggestions as to increasing interest in the Chicago branch. He suggested that it might be well to combine with some of the other engineering societies in Chicago, forming a general engineering body. Secretary Pope spoke of the present facilities for getting papers rapidly into type and referred to the desirability of authors submitting their manuscript at the earliest possible moment. He thought that in time a local general secretary will be required to take care of the business of local branches.

COOPER HEWITT APPARATUS.

On Monday evening an exhibition was given of the Cooper Hewitt vapor lamp and converter, during which Dr. Von Recklinghausen explained the principles of the apparatus. He traced the use of mercury vapor as a conductor from the work of Prof. Way in 1860, referring to the work of Rappieff, Rosa, Langhaus and Arons. Hewitt's investigations not only taught how the most serviceable illuminating lamps may be made, but opened up entirely new applications of vapor electrical apparatus, the importance of which is far reaching. He showed that to obtain a lamp of the desired characteristics the radiating power of a lamp must be correlated to the energy spent inside the lamp, in order that the most favorable temperature or density conditions may be obtained for the efficient generation of light. An extremely important matter was to get the right ratio between the size of the condensing chamber, the size of the tube and the value of current. Hewitt also demonstrated the means of discriminating between positive electrode resistance, resistance of the current proper and the negative electrode resistance, the last being the most important. To break through the negative electrode resistance requires a good many thousand volts, after which but a few volts are required to keep the lamp in operation. He spoke about the great value of the Cooper Hewitt lamp for photographic purposes, owing to the light being extremely actinic; and the presence of these rays have led physicians to take a great interest in the lamp, as they expect to utilize it in curing certain diseases. Owing to the absence of red rays, the lamp furnishes a splendid light for places where fine mechanical work, reading, writing, and especially drafting, is done. Mr. P. H. Thomas described and showed the single-phase vapor converter, the latest development of Mr. Hewitt's work. In the polyphase converter there is never any interruption of current in the globe, and therefore no trouble is met in keeping the converter in continuous operation. In simple single-phase converter, however, the current would be interrupted at each alternation, whereupon the negative electrode resistance would assert itself. To obviate this, an auxiliary current is continuously passed through the converter, thus preventing the negative electrode resistance from asserting itself, which current may be derived from the main circuit through a shunt containing an inductance. Mr. Thomas described a vapor switch consisting of two electrodes in a sealed glass chamber, covered with mercury when the switch circuit is closed. By tilting the chamber so that one electrode emerges from the mercury, the circuit is interrupted. The circuit, however, is not broken at a high voltage that may exist in an alternating-current circuit when the electrode is bared, the current continuing until the cycle attains about 14 volts from zero, when the current is extinguished and will not start up again owing to the existence of the high negative electrode resistance. The advantages given for this type of the switch are that the contacts are perfect and will not deteriorate nor burn, and owing to the very short distance through which the current needs to be carried, it is easy to get a large cross-section, which makes a light apparatus. In reply to a question as to whether the efficiency of the vapor converter is measured solely by the ratio of the volts supplied to the converter and the 14 volts drop across the converter, Mr. Thomas replied that the only loss corresponds to this ratio.

Dr. Von Recklinghausen, in reply to a question, said that the converter will stand a variation in voltage from 7 to 8 per cent. either way. If the variations are excessive the lamp will go out. A lamp designed for a normal current of 3 amp. will not operate below 1.2 amp. Lamps can be made, however, for very low and very high currents. The lamp will operate with a trace of foreign gas, but with more than a certain small amount the lamp will not work satisfactorily. He said that experiments had been made with nitrogen, with which gas the color of the light is different from that when mercury is used. Some experiments have been made whereby the actinic rays are transformed by fluorescent action. So long as mercury does not contain a gas it does not matter whether it is particularly pure. As to the life of the lamp, he said that no lamps are given out having a life of less than 2,000 hours. The candle-power drops slightly, due to discoloration of the glass. The life of the lamp is terminated by the vacuum becoming poor and the leakage in all probability is lengthwise through the platinum wire sealed in the glass. After the lamp has gone out, it is re-exhausted and then is as good as a new lamp. A special glass is used for making the tubes, its composition being a secret. With some types of lamps it is necessary to have a ballast resistance. Lamps can be constructed for a voltage as low as 15 volts. In starting, a lamp will take 4½ to 5 amp., and then in a few seconds work down to 3 amp. A separate starting device is used for each lamp or each series of lamps. Heating the mercury will not assist in starting up the lamp. At a voltage of 120 there are 15 volts in the electrodes and 20 volts in the ballast, this giving 85 volts in the lamp. The negative electrode has a lower temperature than the positive electrode, energy being absorbed at the former. A jet of flame is given out at the negative electrode, which is deflected by a magnet, but no cathode ray action has been detected. The lamp has an efficiency of .3 watt per hour candle-power, which figure takes account of the electrode resistance but not of the ballast. The pressure in the lamp is about 2 mm.

In reply to a question from Mr. Mailloux, Mr. Thomas said that the vapor converter will eventually be used for railway work. At present no practical apparatus is being made, all attention being directed to studying the different problems presented in its development. He said, however, that a converter had been made through which 120 amp. would pass continuously. As to cost, he said it was the plan of the company to collect statistics as to the cost of rotary converters and base the selling price of the vapor converter upon this. As to overloads, the only difficulty is with respect to the heating of the electrodes and globes. The heating is in proportion to the current, but not to its square. While a vapor lamp will go out under too great fluctuations of voltage, this is not true of the converter with respect to fluctuations in load.

HIGH-SPEED ELECTRIC RAILWAY PROBLEMS.

One of the most important papers read before the meeting was that of Mr. A. H. Armstrong, having the above title. The paper is of particular value on account of the great amount of data which it contains in the form of curves. There are seven sets of curves based upon three friction curves that have been very carefully determined, one of which applies to the operation of a car weighing in the vicinity of 40 tons; another for two cars in a train, and the third to eight or more such cars in a train. With these curves as a basis, other curves are calculated, showing the possible schedule speeds and the energy consumption required for the given speeds up to and including 75 miles per hour maximum, the gross accelerating rate being assumed to be 120 pounds per ton, the average braking effort at 120 pounds per ton and the duration of stops 15 seconds, the track

being assumed to be perfectly straight and level. One set of the speed and energy curves refers to the first-mentioned friction curve, another set to the second friction curve, and the third set to the third friction curve.

The paper also contains four other sets of curves, which, together with those first mentioned, furnish a complete basis for calculations for a proposed electric road, and they are applied in the paper to a case of a third-rail road 100 miles long, on which stops of 15 seconds' duration will occur every four miles, the motors being supplied with direct current from sub-stations fed from a single central generating station. By reference to the curves, it is found that a schedule speed of 40 miles per hour can be obtained with a maximum speed of approximately 48 miles per hour with one stop every four miles, the consumption being 82 watt-hours per ton-mile, with four 110-hp motors operating a single 40-ton car with a temperature rise of 60°. These data enable the sub-station equipment to be calculated, and finally the approximate first cost per mile for a single-car train and the approximate first cost per mile for a two-car train. The example serves to illustrate the great value and very broad application of the curves given. Although it is necessary to assume a number of constants, such as acceleration, braking, coasting, etc., these pertain to average operation and can vary considerably without making a serious difference in the results. The contribution of Mr. Armstrong is consequently a most valuable one to practical electric railway engineering.

STORAGE BATTERY INDUSTRIAL LOCOMOTIVES.

A paper by Mr. F. L. Sessions with the above title contains descriptions, together with illustrations, of several types of storage battery locomotives and gives a number of tables of data, as follows: The kw-hours and draw-bar pull required to move one ton 100 ft. under different friction loads and on various grades at any speed; the total loads in tons that can be held by a 100-kw-hour storage battery 100 ft. per minute, the locomotive having an efficiency of 100 per cent.; the kw-hours required to move 100 tons 100 ft. per minute under different frictional loads and on various grades when the locomotive efficiency is 100 per cent.; the kw-hours required to change a battery to move one ton 100 ft. when discharging at various rates and operating trains against various loads and grades, the energy efficiency of the battery on an 8-hour discharge rate being 75 per cent. and the locomotive efficiency being 100 per cent.; and the total kilowatt-hours available and the kilowatt discharge rates for storage batteries of different 8-hour ratings. In conclusion, Mr. Sessions stated that from results obtained through both calculation and experience, it appears that the electric storage battery when properly designed for its duties can be employed with greater advantages and economy than any other known form of energy storage supply for industrial locomotives.

Mr. Sessions, in reply to a criticism, said that he did not consider a circuit-breaker introduced complication if of a special form particularly adapted for the work it has to do. He admitted that a table referred to by Mr. Berry was not entirely accurate, but considered that an error of 2½ per cent. is hardly worth considering, as the refinements of the art are not such as to demand calculations within that limit. Referring to criticism of another table, he said that storage battery capacity depends so radically upon the method of forming plates that the figure which he gave is justifiable. The use of resistance in connection with storage batteries has proved a very satisfactory arrangement, the energy losses not being considered large enough to be ordinarily an objection. As to charging a battery whilst the line is supplying current for operating a locomotive, the method had proved highly satisfactory and economical in several instances. Mr. Elmer E. Sperry considered that the storage battery locomotive is going to fill a need that compressed air has failed to meet. He referred to some comparative tests of the storage battery and compressed air locomotives, which showed a marked superiority of the former. In the case of a compressed air locomotive using air under a pressure of 3,700 pounds to the square inch, the amount of energy capable of being supplied per ton of equipment, was, as compared with the storage battery locomotive, less than one-quarter. Moreover, the efficiency of the compressed air locomotive decreases as the pressure lowers, whereas in the case of the storage battery, the efficiency curve is almost ideal. The storage battery locomotive is particularly suitable for yard and mining use and in other cases where wiring over tracks is objectionable.

PREDETERMINATION IN RAILWAY WORK.

Mr. F. W. Carter in a paper with the above title, lays down a method whereby, given the profile of a road with its stops, curves, etc., and the particulars of the train and its equipment and the mean voltage and train friction, a time table for the train can be laid down and the energy it requires calculated. The paper first discusses the kinematics of the subject, after which it is shown how to determine the energy used and the motor losses. Illustrative examples follow the general treatment. The information necessary in employing the method is given in the form of curves and simple equation, which can be used without reference to the underlying analysis. The author first lays down universal speed time and distance curves which can be applied to any practical conditions. The author then establishes a current equation and equations for the energy required and for the copper and iron losses. With these data all the constants corresponding to a given railway problem can be very simply and accurately determined. The final portion of the paper gives practical examples worked out according to the method laid down.

Mr. C. O. Mailloux spoke highly of the paper by Mr. Carter and then proceeded to a discussion of plotting railway curves by the point to point method, which method involves no assumptions whatever, with a possible exception relating to the rate of retardation in braking; all the data can be obtained from the starting tests and experiments, and once the fundamental curve is obtained it is possible to plot curves for any set of conditions with accuracy. The method of Mr. Carter approximates this method, which formed the subject of a paper by Mr. Mailloux at the Great Barrington meeting. He pointed out that plotting acceleration curves for all sets of values and for all possible conditions, leads to complication, which is an objection to one part of the method outlined by Mr. Carter. He spoke of an improvement to his own method, made by Mr. Freudenberg, of Lehigh University, which simplifies somewhat the method. In conclusion Mr. Mailloux said that by his method or that of Mr. Carter, the solution of a problem becomes nothing but a matter of simple mathematical manipulation. One can introduce changes of grade and distances of resistance and all possible conditions and have them absolutely correct and determine the results without any approximations.

INTERURBAN CAR TESTS.

Prof. W. E. Goldsborough and Mr. P. E. Fansler, in a paper, gave the results of tests made on the cars of the Union Traction Company of Indiana. This company operates a system extending over five counties and connecting the principal towns between the cities of Indianapolis, Anderson, Muncie and Marion, Ind. At the time of the tests the company was operating over about 160 miles of track, 100 miles of which is interurban, the remainder local. The tests were made on the interurban line between Indianapolis and Muncie, the country being quite rolling with few level stretches. The grades as a rule do not run above two per cent., although there are a few which run as high as three per cent., but they are relatively short. The paper gives the method of the tests and is accompanied by a large number of curves representing test data. The tests are discussed at considerable length with relation to the maximum and minimum kilowatt-hour consumption over the road, the general effect of stops and the personality of the motormen as factors in car consumption economy. Special car tests were also undertaken to ascertain how nearly the car equipments were being worked up to their rated capacity.

After reading his paper, Prof. Goldsborough added that in a case where coal is very expensive and the cost of power very high, a condition might arise under which it would be advisable to select a motorman to operate cars only in one direction and then ride back doing no work, having other men take the cars in an opposite direction, the reason being that it was found that some motormen are more efficient in taking grades and curves in one direction than in an opposite direction. Messrs. E. P. Roberts and I. H. Sherwood submitted a communication giving an account of car tests over the line of the Northern Texas Traction Company. In the discussion of the results it was shown that the average output of the motors was slightly over one-quarter of the rating, this not considering the time for lay-over, which gives an opportunity for cooling. The tests indicated the advisability of considering heating effect as well as rated horse-power; also the gear ratio required to obtain a specific schedule, and whether it is necessary to climb over grades in multiple in order to maintain the schedule, or whether a series connection will ordinarily be sufficient.

ELECTRICAL AND MECHANICAL SPECIFICATIONS OF TROLLEY INSULATOR.

Prof. Samuel Sheldon and Mr. John D. Keiley contributed a paper entitled, "Some Recommendations Concerning Electrical and Mechanical Specifications of Trolley Insulators." With a view to formulating specifications of such material a series of tests were made to determine the electrical and mechanical properties of materials used in the manufacture of trolley insulators, and the paper describes the manner in which these tests were conducted and gives the results. As a result of the tests, the following specifications were formulated, the specifications applying to "Globe" and "Brooklyn Strain" insulators:

All samples tested shall break in the eye. The average ultimate tensile strength of all samples subjected to mechanical test shall not be less than *A* pounds, and no individual sample shall show a tensile strength of less than 85 per cent. of the average tensile strength of all the samples that are tested. The average break-down voltage, for samples which have been broken in the eye in the mechanical test, shall not be less than *B* volts, and no individual sample shall break down at less than 90 per cent. of *B* volts.

As to the values to be specified for ultimate tensile strength and break-down voltage, the following are suggested, where high-class insulators for use on 500-volt lines are to be specified:

	Ultimate tensile strength in lbs.	Breakdown voltage.
2½ inch globes	6000	7000
3 inch globes	9000	10000
Small Brooklyns	9000	10000
Large Brooklyns	18000	10000

Owing to the comparatively low softening temperature of the insulating materials generally used, and to the close proximity of the working conductor when in service, it is important that specifications for round-top hangers should impose a test for softening temperature, and the following is suggested:

Round-top hangers when suspended free from draught in an inverted position by means of a bronze ear weighing 8 ounces and being 5½ inches long, the ear clamping the middle of a round rod of soft iron ¼ inch in diameter and of at least 20 inches length between connectors, must be able, without breaking down or becoming permanently deformed by more than 1/16 inch, to sustain a weight of 200 pounds from the cap for one hour, a current of 200 amp. being passed continuously through the iron rod, the rod being cold at the start.

Mr. Joseph Sachs highly commended in general the recommendations of the paper, but considered that the mechanical test was defective in that it did not take account of the knocking and vibration to which an insulator is subjected in regular service. All trolley line insulators should, moreover, be so constructed that under service conditions the two parts cannot be torn asunder should the insulator be ruptured. He thought that the strength recommended—18,000 pounds—was rather high, as it is seldom that insulators in actual continuous service are subjected to a strain of more than 8,000 or 9,000 pounds. The softening point of trolley line insulators can be increased, but at the expense of insulating properties, for the reason that increasing the strength necessitates adding ingredients such as metallic oxides having a high specific heat, thus bringing down the insulation resistance and dielectric strength. He considered that too much stress was laid on dielectric strength and not enough on surface insulation, as more trouble arises from surface leakage than from actual puncturing. He believed that small insulators should be subjected to the same break-down tests as large insulators. It is a simple matter to obtain a high initial insulation resistance, but the presence of a crack and of moisture lowers this very considerably. In tests of insulators, leakage, internal resistance and dielectric strength should all be considered. Mr. Mershon said that if the tests had been made with direct current better results would have been obtained for the reason that under alternating current insulators containing shellac soften to a great extent. Mr. Sachs added that alternating currents produce a hysteretic effect in insulators, which of course is not present when they are tested with direct current. Mr. Mershon said in some tests which he had made the softening effect was present in a marked degree, the insulator when tested with alternating current softening and breaking down after a time, whereas when direct current this did not occur. The insulators were tested at a frequency of 60 cycles and 500 volts, the length of the test being several minutes. Mr. Sachs said that the matter of the softening of insulators is merely a question of the amount of surface. Dr. Sheldon considered that the break-down test is properly made with alternating current for the reason that an insulator is subjected to inductive kicks, which are much more of the nature of an alternating than a direct-current effect. In the test described, surface leakage was taken into account. Mr. Mershon disagreed with Dr. Sheldon, being of the opinion that the test should not be made with alternating current owing to the heating action, which does not accompany inductive kicks. Mr. Sachs said that while the softening effect had been noted when alternating current was used, it was absent under direct current.

THE STORAGE BATTERY IN SUB-STATIONS.

In a lengthy paper on this subject, Messrs. W. E. Goldsborough and P. E. Fansler give a complete report of a test made in 1902 on the large interurban system, with nine sub-stations, of the Union Traction Company in Indiana. At the time of the test the company operated over 160 miles of track. At the main station the generators give alternating current at 400 volts. It is stepped up to 16,000 and transmitted to the sub-stations, where it is stepped down to 330 volts. Synchronous converters then change the current to 550 volts direct current, which is used on the trolley system. One sub-station contains three 250-kw converters, a 20-kw booster and a battery of 264 chloride cells, giving 400 amp. for one hour and 100 amp. for 8 hours. Five other sub-stations are equipped each with a 250-kw converter and a battery of 264 cells, giving 160 amp. for one hour and 40 amp. for 8 hours, and an 8-kw booster. The remaining three sub-stations contain each two 250-kw converters, one 16-kw booster and a battery of 264 cells, giving 320 amp. for one hour and 80 amp. for 8 hours. The all-day efficiency of the high-tension distribution from the low-tension bus-bars in the generating station to the direct-current terminals of the rotaries was found to be 73½ per cent.

In each sub-station the booster is so connected in the battery circuit as to automatically adjust the battery voltage to the demand on the sub-station; in other words, the battery charges and discharges automatically, feeding out to the line when the demand is above a given amount, and being charged by the rotaries when the demand falls below that amount. The potential at which the battery will float on the system or the demand on the system corresponding to which the battery is inactive, can be adjusted at any point by the switchboard attendant.

In a preliminary test the "efficiency of equalization" in one sub-station was determined. This is defined as the ratio of that portion of the rotary load curve that is above the average load curve to that portion of the line load curve which is above the average load curve. In the sub-station tested this efficiency of equalization of the battery was found to be only 11.9 per cent., which is rather low. This indicated that the adjustment in this sub-station was somewhat faulty.

The results of the main tests of the batteries are given in a great many diagrams. Over four-hour periods, the highest discharge performance in one sub-station was that the battery developed 39 per cent. of its discharge capacity; at three other sub-stations the batteries never developed more than 28 per cent. of their discharge capacity over a four-hour period, and at another station it did not exceed 14 per cent. These figures show that, as gauged by the averaged demand on the sub-stations, the batteries are amply large enough to take care of variation in the demands made on the sub-stations by the trains. It is believed, however—and this has a bearing on the result mentioned above obtained in the special preliminary test—that the motors driving the booster armature were not heavy enough to hold up to the momentary demands which rapid changes in the load bring upon the sub-stations. Heavy balance wheels placed on the booster shafts would cause the batteries to show a very much higher charge and discharge kilowatt performance during four-hour intervals, and they would serve to reduce the fluctuations reflected through the sub-stations from the trains to the central station. An improvement in the variations of the load coming on the central station will in time increase the economy of the generating station. This is a point to which attention should be given in laying out sub-stations for work of this character.

The average commercial performance of five batteries during the three days of the test was found to be 74, 88, 96, 76 and 112 per cent. Taking the ratio of the total discharge of all the batteries to the total charge of all the batteries in these five sub-stations, an aggregate efficiency of 95 per cent. for the batteries in the sub-station is obtained; or if the efficiency values are averaged as obtained for the five sub-stations, the average efficiency of the batteries during the time is 89 per cent. These values are high, and yet they continue so for relatively long periods without any special indications of deterioration in the batteries.

Mr. Stott stated that in the Manhattan sub-stations the rotaries have worked under 68 per cent. overload. He thought a test would be interesting during which the sub-stations were worked one week with storage batteries and one week without storage batteries. Prof. Goldsborough said that in the test he described, it was attempted to cut the storage batteries out of some of the sub-stations, but it was found rather disastrous with respect to the main stations, the engineers in charge not desiring to submit the generating plant to the additional strain. The advantages of the storage battery begins at the generator, since the engines will operate more efficiently when the load on them is maintained constant. Moreover, the current in the high-tension lines and through the transformers and rotaries will be much more constant, and consequently the copper loss will be less. The matter of a storage battery equipment properly adjusted to its work is thus an important element.

OPERATION OF RAILWAY MOTORS IN SERVICE.

Mr. Clarence Renshaw read a paper entitled, "Some Notes on the Operation of Railway Motors in Service." The subject matter is divided into two parts under the respective heads, "The Equivalent Effect of Service Loads," and "Test on Electric Car in Speed Service." The first part describes a simple means by which engineers in charge of railway systems can determine the loads on motors, and whether these loads are within the capacity of the motor or not. An ammeter in the circuit of one motor and a voltmeter at the terminals of the same motor read at suitable intervals during a typical round trip over a given route, give sufficient data for determining the loads which a motor is carrying in service. From the current readings, the root mean square current is found, and from the voltage readings the average or the equivalent voltage. In choosing a motor for a given service, the root mean square current and the equivalent voltage can be calculated from the speed time curves, and a comparison with the values allowable for a motor in question will determine its fitness. Where motors are already installed the continuous equivalent of the service can be found by means of comparatively simple tests, and the relation of actual loads carried by the motors, to their safe capacity, thus determined.| There is a common tendency to select motors which are too small, and such a simple method of determining what are the service loads on an average motor in actual use, or what they will do in a proposed case and whether these loads are within the capacity of the given motor or not, has a wide field of usefulness which a more elaborate method would be unable to reach.

The second part of the paper gives an account of tests on an electric car made over Pittsburg lines. The results of the tests given are not only of interest in themselves, but illustrate the method employed. A simple and convenient method is described for measuring the watts lost in the field of a motor by means of a railway type wattmeter, and of deducing the value of the root mean square curve from this.

Dr. Cary T. Hutchinson, referring to Mr. Renshaw's remark that the predetermination of the temperature rise of railway motors at given loads and under any given service conditions is a difficult and complex problem, said that he had deduced a set of curves by which this predetermination can be made for a motor of any given heat constants; that is, a motor under any load, and any temperature and radiation constants. Knowing these constants, a set of curves can be laid down which will give the temperature rise for any particular run. Calculations are first made and plotted for all variations of initial acceleration, within the range of practical operation and for various values of maximum velocity. The square of the currents is then plotted, there being for each velocity a curve showing the average square of the current, and from these curves the average copper loss is obtained for all initial accelerations. A core loss curve is then laid down, and from this the average loss found for the different accelerations. From these curves the average heat loss in a motor during the acceleration period may be determined. The next step is to determine the ratios of the time of acceleration to the total time, and these multiplied into the average losses at the point of maximum velocity give the average losses during a run. There are also required test records showing the degrees of rise for given watt losses. In addition to determining the average heat losses, a curve of copper and core losses is laid down in such a way that the ratio of distribution is determined for every set of core losses. Knowing then the ratio of distribution for any schedule and the ratio of average heat losses to total heat losses, another set of curves is prepared. Knowing from the several sets of curves what the average losses will be in a motor for every run for each particular acceleration, and knowing the ratio of distribution that pertains to each of these points for each motor by comparison with the test results shown by the motor, the temperature can be determined for any point. Dr. Hutchinson then illustrated by examples how his method is applicable to any given set of curves. An example was worked out for an express run on the New York Rapid Transit.

REVERSE-CURRENT CIRCUIT-BREAKERS.

Mr. Leonard Wilson, in a paper entitled "Reverse-Current Circuit Breakers and the Protection of Transmission Lines," laid down the following as among the more important requirements for this type of apparatus:

(1) A reverse current equal to 25 per cent of the normal must be sufficient to operate the breakers. (2) The releasing force must continue to increase with an increase of the reverse current so that any sticking of the mechanical part will merely cause the breaker to operate at a slightly higher current, and that if the reverse current suddenly attains a very high value the operation of the breaker will be the more certain. (3) A failure of the potential coil from whatever cause arising must not operate the breaker. (4) The device must in some way continuously indicate whether it is in working order or no. The best practice, he said, seems to be to have quick-acting relays set for a moderate return current, 25 per cent. having been found a very suitable value. If for any reason a combined reverse and excess current breaker is required it will be found better to provide two separate tripping coils as a combination of the two in one necessitates a certain compromise in the characteristics of the device.

An efficient system of protection for multiple transmission lines should, while normally allowing all the lines to be in use at once, be capable of preventing any excessive rush of current in case of a fault on one of the lines, and should include devices for entirely cutting out such faulty line without serious disturbance of the rest of the system. Attempts have been made to provide such protection by the use of excess current breakers at the generating end and reverse current breakers at the receiving end, but with very little success, the failures being due to one or both of the following defects in the system: (1) That it does not prevent the sudden rush of current through the healthy mains to the faulty one. (2) In the case of a low resistance fault the pressure falls so low at the receiving end that the reverse current breakers (if they depend on the action of potential coils) fail to operate. This latter defect is obviated by the use of a circuit breaker, which operates when the current in either of the feeders reverses, and it depends for its action entirely on the series current, no potential coils being used. The paper gives a description in detail of an English system devised by Mr. L. Andrews, which includes a choking coil that absolutely prevents any excessive rush of current in case of a fault on one of the mains; this, in combination with automatic cutout devices is stated to fulfil the necessary conditions for complete protection without interruption of the supply.

In reply to an inquiry Mr. Wilson stated that both the positive and negative lines could be protected in the same way, a choke coil being placed in the leg of each circuit. The method can also be applied to a number of lines; as, for example, in the case of a three-phase circuit with 10 or 20 feeders.

President Scott's Address.

The opening portion of the address of President C. F. Scott before the Niagara meeting of the American Institute of Electrical Engineers dwelt upon the wide sphere of action of the electrical engineers and the far-reaching influence of his work. He defined the engineer as "one skilled in the application of the materials and forces of nature to the use of man." Once he dwelt almost wholly with materials—some do so still. Others combine materials and forces. The electrical engineer deals with forces, he energizes and vitalizes the systems constructed by engineers of many kinds. Hence the phenomenal rate of electrical extension—it is not a new thing separate and apart from other things, it enters into them, operates, awakens, unites, combines, transforms.

The advent of electricity as a definite factor in the world's work has produced indirect effects which are even more remarkable than its immediate results. Aside from the fact that many results can be secured more effectively by its use than is possible by other methods, it produces results of a different kind, it leads to new

methods, it revolutionizes the arts and industries to which it is applied and they in turn extend their influences in new ways. It is for this reason that the results of electricity are not definite and simple, but are broad and far-reaching.

The electrical reports in the United States Census show that the mean rate of increase in electrical activity as measured by the capital invested is 20 per cent. each year—it doubles in four years. Technical schools, electrical courses and labratories have increased wonderfully, but their output does not supply the demand. It is the far-reaching influence of the new physical relation which is not so easy to discover.

In this new era the American Institute of Electrical Engineers represents the profession which is youngest in years yet foremost in activity. To meet the present demands of this new era, to prepare for an expanding future, we may well ask, what should our Institute be? What should it do? Shall we adopt the methods of the old-time learned society? Shall we imitate the ways of societies in profession whose methods are established and whose rate of change is slow? Shall we reserve preferment for those with hoary locks or well-rounded years of experience? In this engineering age, this electrical age, so replete with its physical, commercial, industrial and social changes, what are the new conditions, the new opportunities, the new responsibilities which have come to engineers, and how shall we meet those which have come to the electrical engineer?

President Scott then referred to his address of last year on "Proposed Developments of the Institute," in which several specific ways were proposed by which the work of the Institute might be advanced during the year. These suggestions were taken up for review, and their bearing upon the future noted.

As to increase of membership, his convictions were expressed during the year in the following words: "We have failed to catch the spirit of the times and the keynote of electrical progress if we do not realize that we must expand and broaden and progress as well as maintain high standards of excellence. Full membership should be exclusive, associate membership should be inclusive." The membership list on September 15, 1902, included 1,630 names. Since that time nearly 1,000 applicants have been elected as associates. Who are the men who have come among us? What is their age, what has been their training, what is thier present position?

The new men range in age from 19 to 65. The ages of those who have been elected are given below:

Over 50 years, 2 per cent.; 45 to 50 years, 2 per cent.; 40 to 45 years, 6 per cent.; 35 to 40 years, 10 per cent; 30 to 35 years, 24 per cent.; 25 to 30 years, 34 per cent.; 20 to 25 years, 21 per cent.; under 20 years, 1 per cent.

Approximately, 60 per cent. are between 25 and 35 years of age, and are presumably young men who are getting under substantial headway in life and are in their accelerating period.

Forty-four per cent. of these men are graduates of schools of recognized standing. Of the graduates 45 per cent. graduated within the past five years (not including 1903), and 77 per cent. within the past ten years. Cornell University leads the list with 12 per cent. of the graduates; the Massachusetts Institute of Technology is second with 8 per cent.; Columbia, Purdue, Ohio State, Princeton, Worcester Polytechnic Institute, Lehigh, University of Michigan and the University of Wisconsin follow next, and there are substantial numbers from McGill, Stevens Institute, University of Pennsylvania, University of Illinois, University of Minnesota, Pennsylvania State College, University of Nebraska, University of California, Harvard, Yale and Rose Polytechnic Institute. In addition there are representatives from as many other institutions.

The present position and occupation of the new members is difficult to classify definitely and satisfactorily, but a general summary shows the following:

	Per Cent.
Electrical engineers with manufacturing companies	30
Electrical engineers with operating companies	25
Managers and superintendents, duties presumably executive rather than technical	16
Consulting engineers	10
Electrical engineers with mills, mining plants and the like	6
Students	6
Professors and instructors	4
Mechanical and electrical draftsmen	3

Other plans proposed at the beginning of the year were that papers should be solicited and discussions invited from a larger proportion of the membership; local meetings of the Institute in various cities to broaden the interest of its work and generally extend its benefits; universities and technical schools with electrical engineering departments to organize local meetings of the Institute.

These three lines of activity have developed most satisfactorily and are closely related to each other. General plans were presented for the formation of local branches, and such branches have been formed among members in a number of leading cities; also in many of the principal technical schools and universities. In some cases local members and students unite. The methods have been simple, there is a minimum of organization and formality; the primary purpose is to bring electrical men together, to awaken interest, to consider and discuss important engineering topics.

At the beginning of the year definite subjects were assigned for each month for the meetings in New York. Usually several papers were secured from experts upon each subject. Printed copies of the papers together with the stenographer's report of the New York discussion have been sent promptly to the secretaries of the local branches. As the meetings are usually held ten days or two weeks subsequent to the meeting in New York, they have the advantage over the first meeting in having the discussion as well as the papers. This material is presented in suitable form by the members of the local branches and the discussion is continued. Such material as is new and valuable is reported to the secretary for publication in the transactions. By this means the latest phases of electrical engineering work are presented and discussed, not in one meeting only, but from more than a score. Those who have taken up the local work usually report that the interest, the activity and the attendance surpass expectations. In nine cities in which local branches have been formed the total membership has practically doubled. The attendance is not limited to members, as others are welcome. A number of professors have spoken of the interest taken by students and the avidity with which they enter into the work. One professor recently remarked that the Institute papers were giving him a new insight into present electrical engineering and such papers as those upon central station practice made him realize how far practical engineers were in advance of the lecture room and the laboratory.

The element of greatest importance in this extension of Institute work is not so much the mere technical knowledge which it may diffuse, but the broader aspects of up-to-date problems which it presents, and the sentiment of unity and co-operation among electrical men. Electrical engineers have not the advantage of long-time acquaintance to unite and bind them together. Herein we have an effective means of bringing electrical workers together, of uniting them in a common interest, and of directing the studies and the work of young men along definite and effective lines.

At the beginning of the year it was indicated further that the collection of engineering data and the establishment of standard practice in electrical engineering is one of the important functions of the Institute. The present years are formative years. Elctrical engineering is crystalizing. In addition to our Committee on Standardization two new committees have been formed, one on high-tension transmission, the other on engineering data. The Transmission Committee is collecting specific data with respect to present practice in high-tension transmission, and will formulate this data for the use of electrical engineers. It has further prepared a number of short papers as introductions to discussions upon a number of important branches of transmission, which is calling forth the opinion and experiences of engineers at large. The committee is composed of engineers of recognized standing. A consulting engineer is the chairman and representatives from several large manufacturing companis and a Western university complete the committee.

The Committee on Engineering Data has been appointed for collecting and publishing electrical engineering data upon new and special subjects, which are evolving daily throughout the country in the practice of the engineering profession. There is much important data which has not found its way into text-books and hand-books, and about which little is generally known. Such data, if allowed to follow existing channels, either never reach the public, or only after a long period. The committee is composed of men of high standing under the direction of the Electrical Engineer of the Niagara Falls Power Company. The first subject to be taken up for investigation is insulated electrical conductors. Under this general subject is included the heating of cables of various character under different conditions, the life of cable insulation, the methods of

ventilation in conduits, the effects of short circuits and general data bearing upon the operation of cable systems.

Such work as has been undertaken by these committees is of the highest importance to the Institute and its members. These committees are dealing with matters of the most vital importance to substantial progress. They are the means of carrying out one of the highest functions of the Institute in bringing together the diversified achievements of many workers which in the aggregate constitute a single total of accomplishment which we designate as progress. They bring definite positive results out of what is otherwise indefinite and chaotic. They lay the foundation for advancement.

As a further department of our work it was stated at the beginning of the year that the Institute library merits a cordial support. The generous contributions of members in the past have been continued during the present year by substantial additions to the valuable collections, not only in contributions of present volumes, but in endowment provision for the extension of sets which have been presented. Plans are now under consideration for giving the transactions—a panoramic history of American electrical engineering—greater value by preparing a general index to be issued both in pamphlet form and also on cards, which may be distributed alphabetically through the card catalogues of public and private libraries.

The crowning event of the year was in a measure anticipated by these sentences of last September: "Permanent quarters for the Institute should be an object of plans and anticipations. . . . Personal acquaintance and social intercourse are influential factors in unity of sentiment and of action."

The story of our Library Dinner with its distinguished guest, who spoke in happy mood of American engineers and of co-operation among them and of "institutions like this of the Electrical Engineers which do so much," is already familiar to you as well as the events of the following day, when he called to his house two of our members to talk further of what an engineering building should be, and of plans for its realization. Mr. Scott said that he counted as the most memorable privilege of the present year the opportunity given of sitting next to Mr. Carnegie on the evening of our Library Dinner and the hour in his own library on the following afternoon. He was in the best of spirits, alert, active and ever interesting as conversation shifted easily from one topic to another. The talk was pleasant and appropriate to the hour, but never trivial. One topic after another came up, it was the more serious, the more definite, the substantial idea which he brought out before turning to something else. The happy response to his toast was almost throughout a repeating of the ideas and the sentiments which he had expressed in the conversation of the preceding hour.

In discussing at his house the next day the project of an engineering building, his mind was evidently seeking the way and the means by which he could realize an ideal. He was not very familiar with the organization of the several engineering societies, he knew little of their methods and of their financial means and their facilities. But he saw a need, not merely the physical need of accommodations, but the higher need of elevating and developing engineering and engineers. He used about these words: "Yes, engineers need to get together, they need to get acquainted and to meet socially. You can provide for that, can you not?" In his address as president of the Iron and Steel Institute since that time he has discussed methods of industrial organization, particularly the relations between men, and he has emphasized the advantages of a general partnership and common co-operation. When a few days after the first conversation estimates and a general scheme of procedure was presented, Mr. Carnegie did not care to go into the details of method. He seemed to have confidence that engineering organizations could develop their plans in the ways which would be most efficient. He set no restrictions. The great gift to engineering is presented in a single sentence shorter even than the superscription of the letter which proffers a million dollars. Four of the organizations (the fifth has not yet taken final action) which were designated in the letter have without hesitation formally accepted the administering of this generous gift to engineering, and their representatives are now actively developing plans. These plans look forward to the realization of an ideal long cherished by some of the foremost and far-seeing engineers of the country, an ideal in harmony with the new era in engineering and with the trend of American development, an ideal which brings within its scope the advancement of the engineer, and of his profession both within itself and its outward relations. In short, an ideal the realization of which will strengthen modern engineering which is the very basis of prosperity and of progress, and will exert far-reaching influences which are beyond our power to discern.

The remaining specific way mentioned at the beginning of the year for advancing the interests of the Institute was on the co-operation with similar institutions in other countries. The relation of the Institute with the Institution of Electrical Engineers of Great Britain in particular are most cordial and beneficial, and it is hoped to have it meet with the Institute at the time of the Engineering Congresses to be held at the St. Louis Exposition next year. But the idea of co-operation has had its development along domestic rather than foreign lines, and Mr. Scott gave the substance of a suggestion which he presented to the Committee on Affiliated Societies which now has the general subject under its consideration.

First.—A plan should be outlined providing for special departments or sections of the Institute for such lines of electrical work as may demand greater attention than can be given by the Institute as a whole, and which can be more efficiently conducted in this manner than by the formation of new specialized societies.

Second.—Affiliation or co-operation is desirable with other electrical associations by which the Institute may work in harmony along certain lines, such as standardization, adoption of the National Electric Code, the collection of engineering data and other matters of a general nature. Many associations dealing with specific industries have both commercial and engineering interests. I would make the Institute the electrical head or center—the hub—bringing into a unity the electrical engineering of all these associations, not restricting but broadening their work and making them constituent parts of a great whole.

Third.—There is opportunity for close relations between the local branches and local engineering societies or clubs. In two or three cities the local societies are considering plans of uniting work and increasing the efficiency of their societies with local branches of the national societies. The success which has attended the Institute organizations augurs well for further etxension by similar methods for awakening and stimulating a general interest in engineering subjects.

Fourth.—There should be a co-operation—without affecting their present individuality—between national engineering societies in the nature of a National Engineering Congress for promoting closer relations between the various branches of engineering work and for representing the engineering profession as a whole.

Mr. Scott emphasized particularly the establishing of permanent committees to be continued from year to year to carry on lines of work such as the committee on standardization, on transmission, and on engineering data. The value of the results is unquestioned, but the amount of work necessary is not so readily appreciated. We must depend for our best work upon the men who are busiest and who are in a way least able to give it. We must efficiently utilize small contributions of endeavor and assistance from many men. This requires organization and direction, they should have the fullest assistance from men who are paid to carry out directions and care for details by men paid for such work. The Institute expenses do not exceed its income, because the governing body has been watchful, restricting expenditure at every turn. In order to expand and to carry out the lines of work which are most valuable to the members as individuals and for the substantial promotion of electrical engineering and of electrical industries, money is needed.

In the Union Building for the engineering societies it devolves upon the societies to provide the land upon which the Carnegie gift is to be placed. To provide for the Institute in this matter a committee has undertaken the raising by subscription of a fund for this purpose. This magnificent supplement to what Mr. Carnegie is doing will give the Institute its rent free, its building for library and general meetings, for offices, reading and reception rooms, and the like. This will enable funds to be devoted to technical purposes which would otherwise be required for rent, which item is considerable now, and would be greater in the future.

Substantial contributions are anticipated from those who have reaped a rich reward from the applications of electricity. Their wealth has come in no small degree from the work of electrical engineers. Whatever the Institute may do in raising the standards and increasing the effectiveness of electrical engineering brings rich returns to those men and particularly to those companies commercially interested in electrical pursuits. The farmer saves from his surplus the best seeds for the coming season—should not some of the wealth which engineering effort has produced be returned to train men and to develop methods for the future? Is not the whole-

some recognition of the engineering profession by Mr. Carnegie coupled with his generous gift, but the beginning of a new attitude towards engineering and of better things to come? Researches and investigations and tests requiring large sums of money should be undertaken. It is not too much to hope that if we use well the talent which has been given us more may be entrusted to our keeping.

Electrical enterprises depend upon manufacturers, upon industrial captains and financial managers, upon those who construct and apply and use and direct the results of engineering work. It is well for engineers to know these men and to work in harmony with them. The new Union Building—the Capitol of American Engineering—not only brings engineers of different professions together but it recognizes broader relations. It is fortunate that the engineering societies will be adjacent to a social club, "composed of engineers and others who may be interested in or connected with the engineering profession."

The engineer is not merely the man in the closet surrounded by slide rules and tables. There is a commercial side to engineering—not mere selling, but the adaptation of engineering work to definite industrial and commercial conditions in such manner as to bring the best results. We have a professional standing to maintain and ideals toward which to strive, but let us also be awake to the times and in touch with modern methods. Let us make the work, the methods and the ideals of our Institute in full harmony with that profession which deals with kinetic energy—and whose units of measure are the units of activity and whose mission it is to energize, to operate, to awaken, to unite, to combine, to transform, to make effective.

CURRENT NEWS AND NOTES.

DEMANDS OF TELEGRAPHERS.—The telegraph operators of the Pennsylvania Railroad Company have made demands to the officials of the company for an equalization of wages and working hours. The men also ask for a vacation.

OIL SWITCH.—A patent was granted on June 30 to Mr. H. P. Ball, of New York, for an oil switch. A vessel filled with oil, contains a series of insulated contacts separated from each other and immersed in the oil. These contacts depend from a supporting cover, while protecting screens are arranged on opposite sides of these contacts. A bridging rod is provided which can be moved across the oil well to make or break circuits between pairs of contacts. The motions of this bridging rod is controlled by an electromagnetic device, so that it may be operated from a distance. One advantage claimed for the construction is that the bridging devices during their movement are always immersed at practically the same depth in the oil.

STARTING COIL FOR METERS.—A method of compensating friction in electric meters is the subject of a patent granted June 30 to F. P. Cox. In order to overcome the friction which counteracts the tendency of an electric wattmeter to start, various arrangements have been devised in which an auxiliary starting coil is employed, which just balances the frictional resistance. The inventor connects the starting coil in the shunt potential circuit of the meter and secures it to a guide by which it may be shifted relatively to the series field coils which carry the load current. By means of such a coil, adapted to slide to or fro over parallel planes, simplicity and compactness of construction, together with the desired degree of adjustability, is obtained.

PREVENTING HUNTING.—Two patents granted on June 30, to Messrs. E. W. Rice, Jr., and E. J. Berg, of Schenectady, relate to a method of an apparatus for maintaining synchronous rotation of dynamo-electric machines, especially synchronous converters. For this purpose it has before been proposed to encircle the field poles of the converter with short-circuited windings in order to oppose that component of armature reaction which tends to vary the strength of field. The inventors claim that this method has distinct disadvantages, and instead of opposing the variations in the field of the converter, they propose to oppose only that component which tends to strengthen and weaken the pole corners, without necessarily varying the strength of the field. In other words, they endeavor to oppose the cross-magnetizing tendency of the armature reaction. This is accomplished by the use of shunt circuits placed between the field poles or tips and omitted from the field proper.

RADIUM AND CANCER.—A cable message from Vienna, Austria, of July 3 says: "Medical circles here are greatly interested in a report communicated to the Viennese Society of Physicians and read at a recent meeting of the Imperial Academy of Science, to the effect that a long-standing case of cancer was cured by radium rays at the clinic of the late Prof. Gussenbauer. The patient, who was sixty-one years of age, had long suffered from cancer of the palate and lip and had repeatedly been operated upon fruitlessly until the autumn of 1902, when the physicians of the Viennese Hospital declared it was absolutely useless to operate again. One physician determined as a last resort to try radium rays, and treated the afflicted parts by exposing them to the light of radium bromide, the strongest radium preparation in existence. He was rewarded by a gradual and complete disappearance of the tumors. Physicians at the same meeting reported that radium rays had cured a case of melanosarcoma (a tumor containing a black or other dark coloring matter), and several cases of red mole."

ELECTRICAL CONTRACTORS' CONVENTION.—As already announced in these pages, the National Electrical Contractors' Association of the United States will hold its annual convention at Detroit, Mich., July 14, 15 and 16. This is the third annual gathering of the kind, and promises to be in every way successful. With the co-operation of the Electrical Contractors' Association of Michigan an exhibit of electrical apparatus is to be made in the Light Guard Armory, which some of our readers will perhaps remember has having been used for the Street Railway Convention exhibits several years ago. Mr. Frank J. Miner is chairman of the Electrical Exhibition Committee, and informs us that the success of the exhibition is also assured, as the space is already about taken an displays will be made by some of the largest and best concerns in the country. The exhibit will include standard and special supplies and apparatus used for electrical housework, lighting, power and electrical construction. The National Association does not give out any programme as to its proceedings, the business being discussed practically all in executive session. A large attendance of prominent men is already indicated. A special convention train will leave New York for Detroit, via the New York Central & Hudson River Railroad at 8 p. m., July 13. A rate of one fare and a third on the certificate plan has been granted by the trunk line and New England Passenger Associations. Delegates may go to Detroit from Buffalo by steamer or by the Michigan Central Railroad.

LETTER TO THE EDITORS.

Aging of Wood.

To the Editors of Electrical World and Engineer:

SIRS:—For some years I have been experimenting now and then with the rotating disks as described in former articles. I used calcium chloride to remove the humidity and water vapor in the tight boxes containing the disk arrangement, and have frequently examined the condition of the wood and glue used in the interior of the boxes to see in what condition it was required to be to obtain rotations of the disks, as I could obtain no fixed and certain rotation without a long application of the calcium chloride when I used wood under the electrodes. I found that where the wood which was used under the electrodes, that is, when I obtained rotations, had become aged; that its fibres were stiff and more easily broken; and when an attempt was made to bore holes in it, it would be apt to split. The glue became like glass in a manner and held the wood very firmly, but could be more readily torn away, taking part of the wood with it.

I also found that when once it got into that condition neither the wood nor the glue returned entirely to the original condition in which it was before being treated; but I could return it to near its original aged condition by the application of dry heat and obtain rotations of the disks. Now, wood in its normal condition has its fibres generally flexible. These when bent do not always return to their original shape. Of course there is a great difference between different kinds of wood. Where the fibres are treated as above described, they return quickly or break. The glue, if not supplied with an excess of moisture, remains in somewhat the same condition.

I am also led to the conclusion that wood and glue where left for a great number of years will reach approximately the same condition as the wood and glue in the boxes described, and I further believe that the wood from old musical instruments, such as old violins, if

used under the electrodes of rotating disks after a small application of heat would give good rotations.

Take a piece of cardboard, for instance. Before being treated it can be bent into a different shape, but after treatment it will either break or quickly return when bent, showing its rigidity has been increased. Wood and glue in such a condition as described will vibrate much better than when in their ordinary condition, the fibres of the wood being more rigid; and the glue being in a manner like to glass does not allow the vibrations of the wood to be deadened, but holds the wood firmly.

I would think musical instruments, where there is a dependence of the vibrations upon wood, would be improved if treated in the same manner as the wood and glue in the tight boxes.

While the time of treatment depends to some extent upon the condition of the wood, the amount of chloride of calcium and the temperature used, it will not do to treat for only a few weeks, but the treatment must continue for months in an air-tight glass or metal box before the results are obtained. Wood is very unyielding to the treatment, much more so than cardboard.

BALTIMORE, MD. ALFRED G. DELL.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Experimental Investigation of Direct-Current Machines.—ARNOLD.—A very long article, illustrated with numerous diagrams, relating to a study of the phenomena of commutation, the eddy current losses in the armature copper and the determination of the efficiency by running without load and short-circuited. The author first investigates mathematically the form of the current distribution under the brushes, the contact resistance of the brushes and constructs the curve for the mean local current density. Experiments are described which were undertaken to find out whether the short-circuit current curves calculated from the brush potential curves, agreed with those obtained experimentally. The brushes were placed in three positions, namely, in the geometrically neutral zone, in a position 10° in the direction of rotation, and 10° opposite to the direction of rotation for the machine running as generator and as motor; both copper and carbon brushes were used; it was thus ascertained that the curve obtained by integration of the brush potential curves agrees with satisfactory accuracy with the short-circuit current curve found experimentally. The dependence of the short-circuit current on the commutating field is also taken up, as well as the estimation of the curve of the commutating field from the brush potential curves. The author states that the experimental proof has been furnished to show that the curve of the short-circuit current depends primarily upon the amount and direction of the additional e.m.f's. and that it is not correct, in the calculation of the commutation, to take account only of the so-called reactance potential and to consider its amount as only influencing the formation of sparks. The author next takes up the investigation of the commutation with short-circuited machine and states that one should require of a machine which has the right dimensions, that with a position of the brushes most favorable for half load and short-circuited, it should sparklessly commutate half the current. The brush potentials for the loaded machine, which have been obtained by superposition, agree well with those found by experiment. That potential, at which it is still possible to notice the slightest formation of sparks, between the approaching or receding edge of the brush, and the corresponding point on the commutator, is designated by the author as the spark limit. This he finds with copper brushes is 0.15 to 0.25 volts. At potentials above 0.25 volts the sparking can be plainly seen; between 0.38 to 0.55 volts there is strong sparking and a rapid heating of the commutator. Even at potentials of above 0.3 to 0.32 volts the mesh of the brushes is destroyed by the sparks. With carbon brushes the spark limit is variable between wider limits, the material of the carbon, the state of the commutator and the temperature of the carbon playing a considerable part. For one kind of carbon it was found to be between 1.8 to 2.5 volts, while with another it was 2.4 to 2.6 volts; the current density was as high as 20 amp. per sq. cm. These are average values and apply to smooth and not to blackened commutators. Experiments to determine the eddy current losses in the armature copper were also carried out, with 6 amp. of different forms of grooves of a 4-pole 5-hp motor. The bars had different cross-sections and were supported differently in the grooves. The experiment showed that a subdivision of the bars at right angles to the groove is more efficient than parallel to the groove, because the greater part of the eddy current losses is caused by a field at right angles to the groove. The experiments also confirm the experience, that it is advisable to place the massive bars not quite on the outer edge of the groove, because the field of the grooves is very strong there, and that with massive bars of large cross-section high tooth saturations are to be avoided, especially with high period numbers. Experiments are also described to determine the efficiency by running without load and short-circuited.—*Elek. Zeit.*, June 18.

POWER.

Internal Combustion Engines for Driving Dynamos.—HUMPHREY.—A paper presented before the Electrical Section of the English Institution of Civil Engineers, with discussion. The author gives a table of the various types of gas engines, with the number of impulses per revolution and the horse-power up to which each type is constructed. The types are discussed in detail. He thinks that the central station engineer is now fully alive to the fact that the gas producer and gas engine constitute the cheapest means of generating electric power, where coal is the basis of energy. He states that the internal combustion engine is rapidly reaching sizes which are large enough to suit even the large tramway stations, and when suitably designed has proved quite as reliable for driving alternators in parallel, as the best steam engine. In the author's opinion sufficient attention has not been given to the construction of gas engines intended to take a supply of both gas and air, separately stored under pressure. For central stations of large size the previous compression of the gas and air, so that they may be drawn as required from reservoirs, has much to recommend it and involves, with proper precautions, no special danger. The advantage of the two-cycle gas engine would then be attained, without the complication of each engine carrying its compressing plant, together with all the extra valves and gear required. In the discussion the statement was made by Dr. Hopkinson, that at full load the difference between the steam engine and gas engine were quite insignificant, but in considering the conditions of a generating station, where the load factor on the average did not exceed 25 per cent., the comparison took a different turn. Eight pounds of coal per kilowatt was not a bad result for a steam-driven station, but the losses on a gas-producer could be stopped instantly by stopping the gas. A producer which would consume one ton of fuel when running, would not consume more than 20 pounds an hour at the outside when standing idle. It would thus be found that about 3 pounds of coal per kilowatt would be a figure, which would compare fairly with the 8 pounds for steam.—Lond. *Elec.*, June 18.

Dynamos With and Without Accumulators.—PAHDE.—The author gives a detailed statement of the cost of installation and running of a plant furnishing power for a large machine works when the power is furnished by dynamos only or when a storage battery plant is installed to take the peak of the load during the time of maximum consumption. The plant for dynamos only consists of two 700-amp. machines, while a small machine of 232 volts and 70 amp. furnishes power during the dinner hour and the night. There has to be a large and a small reserve machine provided and the necessary amount of boiler capacity. The current consumption from the large machines is irregular and can reach its maximum of 1,400 amp. any time during the day. The machines will, therefore, work uneconomically. For the equipment with storage batteries a large dynamo of 900 amp. is provided, with 1 reserve machine of the same capacity, and a storage battery of a 2,592 amp.-hours' capacity with maximum discharging current of 864 amp. For this case the machine works unin-

terruptedly at full load and the storage battery furnishes the amount required in excess. The author calculates for the cost of running by machines only a yearly outlay of $26,848, and for machines plus storage battery $19,074, showing, therefore, a sum of $7,774 in favor of the latter system. The cost per kilowatt-hour in the first case is calculated as 3.3 cents, and in the second case as 2.22 cents.—*Elek. Anz.*, May 24, 28.

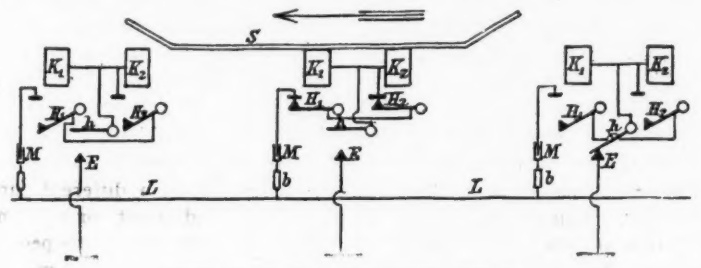
REFERENCES.

Britannia Steel Works, Middlesbrough, England.—A well-illustrated description of the large reconstructed works. Electric driving is used throughout the mill. Each melting furnace has its own ladle and these are most expeditiously handled by three powerful 70-ton electric cranes. The reheating furnaces are fed by an electrical charging machine, the side elevation, plan, etc., of which are given in the article. The straightening machines are also electrically driven. —*Eng'ing*, June 12.

American High-Pressure Hydro-Electric Plants.—PERKINS.—A short illustrated article with a condensed description of the equipment, etc., of several western installations.—*El'ty*, June 17.

TRACTION.

Surface-Contact System for Electric Traction.—LOEWY.—An illustrated description of the various contact systems, from a paper read by the author before the Electrochemical Society of Vienna, with discussion. At the conclusion of the paper the system invented by an Austrian, Dr. Hillischer is given in detail. The advantage of this system is said to be in its simple mechanism, combined with the security which it affords, against the danger of a contact remaining alive, after the car has passed it. The accompanying illustration shows diagrammatically the arrangement, the car being supposed to pass in the direction of the arrow. The system is an electromagnetic one. Two contact points, K_1 and K_2, are connected with the feed cable, L, by means of two levers, H_1 and H_2, of cast iron with a core of cast steel. The contact shoe, S, of the car is an electromagnet, and when it touches the two contact points they also become magnetic and attract the two levers, thus closing the circuit. The two levers do not act at the same time, but one is made heavier than the other, so that the heavier one is attracted last and released first, when the car has passed. By this arrangement of two independent interrupters the remaining alive of a contact is nearly excluded, for the current is interrupted, if only one of them is released. But in order to interrupt the circuit even if both levers fail to fall off, an earthing lever, h, is provided, which connects them to earth as soon as the car has passed. On account of the short-circuit thus produced,



SURFACE-CONTACT TRACTION SYSTEM.

a fuse, b melts, whereby the contacts loose their current. This earthing lever is very light, so that it is attracted easily by the contact shoe. By this means the contacts are disconnected from earth before they come into contact with the shoe. This earthing lever also renders stray currents, which pass from live contacts to earthed contacts, innocuous. Nearly all constructive parts of the apparatus are arranged in the lid of the contact pot, which can easily be removed and replaced by a new one, if necessary. In order to avoid remanent magnetism in the contacts, the electromagnets of consecutive cars are magnetized in opposite direction.—*Zeit. f. Elek.*, May 17, 31.

Electric Traction on Suburban Railroad.—An illustrated description with diagrams, of the equipment of the suburban railroad between Berlin and Lichterfelde, which has been adapted for electric traction. The line is run with direct current at 550 volts, furnished by a 1,600-kw steam dynamo. The trains are composed of two third-class and one second-class motor car and weigh 123 tons. The third rail is supported by a steel casting, which in its turn carries an insulator of artificial granite, on which the rail rests. At road crossings the third rail is discontinued and connection made by cables. Each motor car has two 100-hp motors, so that 600 hp are available for the whole train. After 8 seconds the train reaches a velocity of 4 m per second. Then the motors are connected in parallel, whereby the mean acceleration is 0.21 m per second, so that the train reaches a velocity of 10 m per second in 50 seconds. The controlling takes place by the multiple unit system, with 9 relay circuits of small wires, running through the whole train.—*Elec. Zeit.*, June 11.

REFERENCES.

Electric Railroad from Paris to Versailles.—An illustrated popular article describing this new road.—*Scien. Am. Supp.*, June 6.

The Electrical Equipment of the Mersey Railway.—A long illustrated article on this road, previously described in the Digest.—*Elec. Rev.*, June 20.

Toronto Street Railway.—An illustrated article, describing the power houses and equipment.—*Can. Elec. News*, June.

Hampshire Light Railways.—A short illustrated description of a new line from Portsmouth to Horndean, a distance of 6 miles. Direct current is purchased from the Portsmouth Corporation, feeding at 550 volts, two motor-generator sets, each consisting of a four-pole continuous-current shunt motor, directly coupled to an eight-pole, three-phase alternator. The output of each alternator is 250 kw of 5,500 volts with 375 r.p.m. This current is transmitted to a sub-station about midway along the line, where it is transformed again, the details of the machinery corresponding with that at the main power house.—Lond. *Elec.*, June 18.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Poplar, London, Electricity Works.—A long illustrated article giving a detailed description of the installation for the borough of Poplar in the City of London, England. The district contains the large docks and many large works situated around them. The central portion of the area is fed directly from the generating station, but owing to the elongated shape of the borough, and the large demand for power in the docks at its southern extremity, it has been found necessary to adopt direct-current, high-pressure transmission at 1,500 volts, which is lowered to 460-230 volts in a reducing house near the docks. The steam raising appliances in the station are described in detail. The machinery in the generating plant consists of two 100-kw, four-pole dynamos, coupled to triple-expansion, three-crank engines running at 550 r.p.m., two 200-kw,, four-pole dynamos coupled to engines of similar type, running at 380 r.p.m., and two 500-kw dynamos coupled to triple-expansion three-crank engines at 270 r.p.m. All the machines are shunt wound and generate current at 440 to 470 volts. The auxiliary machinery is described in detail. There are two batteries of 210 cells each. Each battery has a capacity of 600 amp.-hours at 80 amp. discharge rate, and 320 amp.-hours at 160 amp. discharge. Two balancer booster sets are installed, one of which consists of two four-pole balancer dynamos, each rated at 115 amp., 220 to 285 volts at 700 r.p.m., with a four-pole booster coupled between them capable of generating 200 amp. at 0 to 100 volts; the booster is used for charging and regulating the storage battery. The larger set consists of two four-pole balancers, each taking 315 amp. at 220 to 285 volts, at 640 r.p.m., coupled together, with a battery-regulating booster of 380 amp. capacity at 0 to 100 volts coupled to one end of the shaft, and a generator of 90 amp., 570 volts, coupled to the other end. The last-mentioned machine is used in connection with the high-pressure transmission system at light loads. The generating station bus-bars are boosted up 500 volts on either side, either by steam or motor-driven boosters, making the pressure between the high-tension bus-bars approximately 1,500 volts. High-tension feeders from these bus-bars go to the reducer house sub-station; the current they carry passes through the reducers and is delivered on the reducer house low-tension bus-bars at 460 to 520 volts, according to the amount of regulation on the reducer fields. Each line of reducers is composed of two separate machines mechanically coupled, each having a doubly-wound armature and an auxiliary magnet system, by means of which latter the low-tension voltage from the machines may be varied over a wide range. In the reducer house are three lines of reducers, each line having an output of 300 kw. There are also two auxiliary field type balancers, each capable of dealing with 200 amp. of unbalanced current in the middle wire. A diagram shows the high efficiency at light leads. The low and high-tension switchboards are also described in detail, as is also the distributing system.—Lond. *Elec. Eng.*, June 19.

REFERENCE.

Electrical Installations in a Theatre.—A description of the electrical installations in the Prince Regent Theatre in Munich, with

details as to the distribution of the current on a large stage, for obtaining the scenic effects. Current distribution takes place by the three-wire system for 2 x 110 volts, 264 storage cells with a capacity of 855 kw-hours are installed.—*Elek. Rundschau,* June 15.

ELECTRO-PHYSICS AND MAGNETISM.

Radioactivity of Ordinary Materials.—STRUTT.—The author has carried out a series of experiments with a view to decide whether the nature of the walls of a vessel had any influence on the rate of discharge of a charged body inside of it. The walls of the vessel used could be lined with any desired material by inserting a cylinder composed of it through the removable bottom. The author found that there were very marked differences in the rate of leak when different materials constitute the walls of the vessel. He finds the following figures in scale divisions per hour: Tinfoil, 3.3; another sample, 2.3; glass coated with phosphoric acid, 1.3; silver chemically deposited on glass, 1.6; zinc, 1.2; lead, 2.2; copper (clean) 2.3; copper (thoroughly oxidized), 1.7; platinum (various samples), 2.0, 2.9, 3.9; aluminum, 1.4. He states that there can, therefore, be little doubt that the greater part, if not the whole of the observed ionization of air is not spontaneous at all, but due to Becquerel rays from the vessel. It is interesting to find that the phenomena of radioactivity, which have hitherto been regarded as rare and exceptional, are present everywhere. The rate of leak with various pieces of tinfoil from the same stock was always the same, as nearly as the experiments could show, but a piece from another stock gave a different amount of leakage. The same holds good for platinum, one specimen tried being twice as active as another. Ignition did not affect the radioactivity of a given sample of platinum. The above-mentioned substances were then compared for activity with uranium nitrate, which latter was found to be 3,000 times greater. The author thinks that it is possible that this radioactivity of ordinary materials may be due to traces of the more active substances; which would explain the varying activity of different samples of the same material. Only an infinitesimal proportion of radium would be required, as it is at least 100,000 times more active than uranium, and uranium 3,000 times more active than the most active common material he experimented with, so that one part of radium in three hundred million would suffice to account for the observed effects.—*Phil. Mag.,* June.

Electrostatic Deflection of Rutherford Rays.—DES COUDRES.—An illustrated paper, in which the author describes experiments by which he succeeded in showing that the above rays can be deflected by an electrostatic field. From these experiments he deduces the velocity of the rays as $= 1.65 \times 10$ to the 9th power, or about 1/20 the velocity of light. He confirms Becquerel's result for the deflection in a magnetic field.—*Phys. Zeit.,* June 1.

Ionization of Air by Water.—HIMSTEDT.—The author found that air, which was furnished by an ordinary water-jet pump, showed a much higher conductivity than ordinary room air. The result was not due to its containing a larger amount of water vapor, as it did not disappear when the air was dried by conducting it through long tubes filled with phosphorus pentoxide, or by letting it stand over phosphorus pentoxide and metallic sodium. The high conductivity could, however, be completely taken away, by conducting the air through a coil dipping into liquid air. If after such an experiment the coil was allowed to rise again in temperature the high conductivity of the air was re-established. All experiments to find a radioactive agent in the substance, which had frozen out in the coil, failed. When air was forced under a certain pressure through distilled water, rain water, hydrant water and solutions of sodium chloride, copper sulphate and sulphuric acid, the same amount of conductivity was given to it. No increase of conductivity could be observed when air was forced through petroleum, paraffine oil or benzine.—*Phys. Zeit.,* June 1.

Crystallization in the Electric Field.—SCHMIDT.—An article, illustrated by a diagram, describing an experiment in which the author allowed a solution of sulphur in carbon bisulphide, to crystallize in an electrostatic field, maintaining a difference of potential of about 40,000 volts. The surprising result was obtained that the crystals of sulphur were obtained only at the anode, the cathode being entirely free from crystals. The author thinks that the phenomenon can be explained by assuming that the crystals of sulphur in nascent state take an electronegative character, and are therefore repelled from the cathode.—*Phys. Zeit.,* June 1.

The Volta Effect.—SIMPSON.—The author measured the difference of potential between a cage of galvanized iron wire 1 meter high and wide and ½ m. long, and various metals in the form of wires, sheets or gauze, which were supported on a isolated support. The cage and one pair of quadrants of an electrometer were connected to earth, while the metal was connected with the other pair of quadrants. The difference thus found was negative for sodium and for an alloy of magnesium-aluminum (magnalium), and positive for the other metals investigated. The results were: Copper, + 0.7; iron, + 0.40, tin, + 0.25; lead, + 0.23; magnalium, — 0.28, and sodium, — 0.70 volts. These numbers agree very well with the Volta difference of potential between these metals and the zinc, the cage acting as the zinc electrode.—*Phys. Zeit.,* June 1.

UNITS, MEASUREMENTS AND INSTRUMENTS.

The Giorgi System of Units.—EMDE.—A long description of this system preceded by introductory remarks and including a large table of comparisons of various systems. The system was described by Giorgi in *L'Elettricista,* January, February and November, 1902. It appears to consist chiefly in using the weber and kilogram in place of the centimeter and the gram, as the fundamental units, and in shifting the troublesome factor 4π by taking it out of the value of the magnetomotive force, magnetic induction and what he calls the electromagnetic conversion factor, and placing it into the value of the permeability, thereby eliminating it from the more important relations between various units, and making it possible to measure with nearly every unit both an electrical and a magnetic unit, thus reducing the number of units to nearly one-half. It is claimed to give a "rational" and consistent system involving scarcely perceptible changes; also that it brings into better record the systems of measurements of the mechanical and the electrical engineer and requires no international agreement for its adoption; it is also thought to facilitate instruction. The electrical units remain the same and the ampere-turn becomes the unit of magnetomotive force.—*Zeits. f. Elek.,* June 7.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wave Telegraphy to and from Moving Trains.—SCHMIDT.—The conclusion of the article previously noted in the Digest. The present installment contains an account of the experiments carried out under the supervision of the German Government on the Berlin-Zossen military road. Waves of 200 m. length were used and the conductor on the train consisted of a wire, strung on insulators along the upper edge of the cars. The waves traveled along wires on the telegraph poles. It was found that satisfactory communication with the station could be had for 20 km, 10 km before and behind the station. It was also found that although the wires were carried on the telegraph poles, that neither the telegraph nor the railroad signal service was affected in any way by the waves and the telephone only to a slight degree. A slight crackling noise is heard in the telephone, but it is not strong enough to interfere with communication. The wave telegraphy, however, was strongly disturbed by the telegraph service, because the small sparks which appear at the telegraph instruments gave rise to rapid electrical oscillations, which traveled along the conductor and influenced the coherer. This disturbance was finally overcome by suppressing the sparks by connecting polarization cells or inductionless resistances in parallel to the telegraph keys.—*Elek. Anz.,* June 18.

Electrical Syntony and Wireless Telegraphy.—MASKELYNE.—A discussion of the manner in which the author succeeded in interfering with Prof. Fleming's recent lecture experiments on syntonic electric wave telegraphy with the Marconi system before the Royal Institution. It was done to test the Marconi people's claim of having perfected the tuning devices and to see whether any interference was possible with an ordinary 10-inch induction coil, fitted with a mercury jet interrupter, running at 2¼ amp. primary current. No attempt was made, according to the author, at tuning the receiver. This interference drew forth an angry letter from Fleming in the *Times* of June 11, to which Maskelyne replied as the author of the interference, giving his motives for doing so and repudiating the charge of "scientific hooliganism," made in Fleming's letter. Then followed another letter of Fleming, which was in turn followed by another one from Maskelyne calling attention to several contradictions in Fleming's lectures. These letters are reprinted after the article under consideration. The subject is attracting considerable attention in England, being made the subject matter of editorials in the Lond. *Elec. Eng.,* Lond. *Elec. Times,* and Lond. *Elec. Rev.,* the editors being inclined to take Maskelyne's part. The Lond. *Elec. Rev.* goes so far as to remind Fleming that in his dual capacity of savant at a learned

institution and expert to a commercial undertaking, the public have nothing but courtesy and respect to offer to the one, while they have searching criticism and still more searching experiment to oppose to the statements of the other.—Lond. *Elec.*, June 18.

MISCELLANEOUS.

Danger to Firemen from Water Thrown Against Wires Carrying High-Potential Currents.—HEINCKE.—A description of experiments made to ascertain whether there is any danger and if so how much, of firemen being exposed to shocks by the stream of water which is thrown from the hose, striking against a live wire. The author experimented with ordinary hydrant water, which in his case was not a very good conductor, and also with water to which was added 0.5 per cent. of soda to make it conduct better. The copper nozzle of the hose was very well insulated from earth and the potential of the stream of water against the earth was measured with precision voltmeters. From these potentials he calculated the current strength, based upon the resistance of the human body of 15,000 ohms, as ascertained by Prof. Weber in Zurich. Experiments were conducted with triphase current of 6,000 volts and 125 volts, and direct current of 240 volts and 550 volts with both kinds of water mentioned above. Detailed tables of the results are given. The experiments with triphase current were conducted with star connection, 6,000 volts between two lines, the neutral wire being earthed. The places where the stream of water struck the wires they had been previously bared. It was shown that with ordinary water a length of the stream of 300 mm is sufficient to render the effects of the electric current on the body harmless, while with 0.05 per cent. soda in the water the minimum length is 1,000 mm. It is to be remarked, however, that disagreeable sensations still show themselves in the body of the person under consideration. With the experiments of 3 × 125 volts alternating current, a dangerous potential was not reached, as was the case also with 240 volts direct current. With 550 volts direct current and pure hydrant water a dangerous potential was also not obtained, but with the good conducting water it showed itself at a distance of 80 mm. It is shown by these tables that the danger resulting from the playing of water on current conducting wires is not by far as great as had previously been thought and feared, especially if it is considered, that perhaps only in the rarest cases have wires which carry a potential of 3 × 6,000 volts will come into consideration.—*Elek. Zeit.*, June 18.

New Books.

PROCEEDINGS OF THE TENTH ANNUAL MEETING OF THE SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. New York: Engineering News Publishing Co. 300 pages Price to members, $1.50; to libraries, $2.00; to others, $2.50.

This is a well-edited volume nicely bound in sky-blue. It commences with lists of officers, to the number of twenty-five, and members to the number of 278, by one method of reckoning and of 275 by another. The constitution then follows and is succeeded by the Proceedings.

The proceedings embody a presidential address, and thirteen papers on educational topics, with discussions. The papers are very interesting and of a high standard. The discussions are also clear and well-worded, with special interest, as revealing the diversity of opinion which exists and perhaps always will exist on such questions.

At the end of the book, before the index, are five important statistical tables containing engineering educational data derived from 118 colleges or technical institutions, nearly all on the North American continent.

These tables will bear much study and pressure for the extraction of useful material.

They show, among other things, that the number of enrollments of students in engineering courses in the United States is 16,433, with 15 females, or one female per thousand enrollments. The number of academic or non-engineering enrollments in the same institutions is 18,830, of which 12,457 are males and 6,373 (33.8 per cent.) females. Consequently the tables show that taking the returns of these 118 institutions, there are nearly as many engineering students as non-engineering students, and restricting consideration to males, there are 132 engineering students to 100 non-engineering students. The proportion varies greatly in different institutions, some of the technological colleges having no academic or non-engineering enrollments, while others have very few engineering students.

It is not clear whether these statistics cover all the educational institutions of any importance, or whether they are picked colleges, but the evidence seems to be that all have been consulted.

Directory of Electrical Societies, Etc.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, W. H. Johnson, Philadelphia, Pa.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y. Next meeting Atlantic City, N. J., September 2, 3 and 4, 1903.

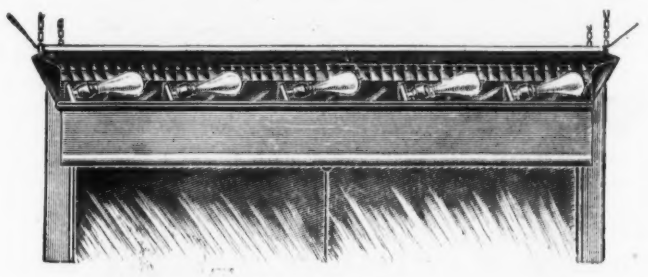
NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Annual Convention, Detroit, Mich., July 14, 15 and 16.

AMERICAN STREET RAILWAY ASSOCIATION. Secretary, T. C. Penington, 2020 State Street, Chicago. Next meething, Saratoga Springs, N. Y., September 2, 3 and 4, 1903.

THE ELECTRICAL TRADES SOCIETY (Member National Electrical Trades Association). Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets every second Friday of each month.

Window Reflector.

The window reflector shown in the illustration herewith, made by Mr. Nelson Weeks, 217 William Street, New York, departs from conventional lines in one respect, which is claimed to be an important improvement. It is a well-known fact that the method of illuminating a show window from the top is the most desirable method on account of the direct illumination that is given, and the fact that the lights do not interfere in the slightest with the view of the window decorations or articles shown. In the Weeks reflector, the lamps instead of being laid lengthwise throughout the entire width of the reflector, project at a slight angle from it. The illuminating effect is equal to the case where the lamps are laid in the



WINDOW REFLECTOR.

other direction, but by thus tipping or planting the lamps it is possible to add other lamp bases under the projecting face of the lamp, so that more lamps can be installed in this type of reflector in a given length than other reflectors of the same dimensions. It is stated that this has been found to work so satisfactorily that one of the large construction companies of New York after making exhaustive tests of this kind of window reflector with others, selected the former for use in large department store work.

Push-Button Telephone.

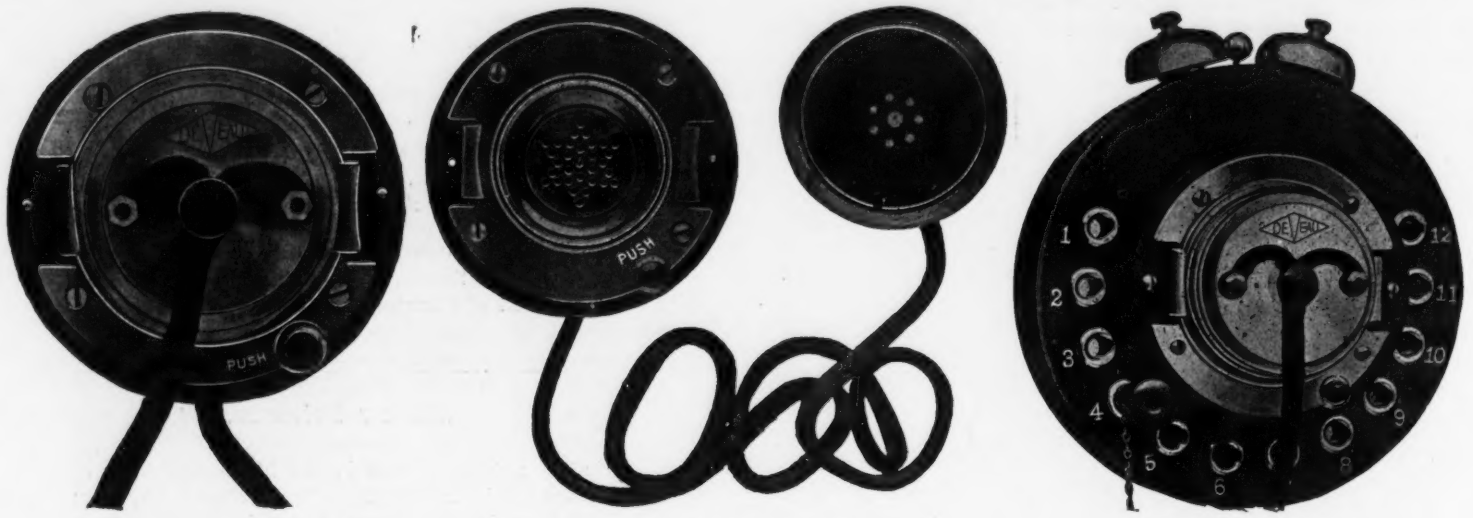
The accompanying cuts illustrate a type of push button telephone being placed on the market by the De Veau Telephone Manufacturing Company, 27 Rose Street, New York. As will be seen, it resembles the ordinary push button, and can be used as such, but is yet a complete telephone instrument and may be used for intercommunicating, switchboard or straight line work. The instruments are equipped with double-pole receiver and long-distance transmitter. All springs are of phosphor-bronze, have a long leverage and are not turned at short angles, and thus are not weakened and apt to break. The base of the instrument is of composition and the metal parts may be finished to match the hardware.

The dimensions of the wall set are: Diameter, 3½ in., and depth, 2

in. The size of the intercommunicating block used with the wall set is: Diameter, 5¼ in., and depth, 1½ in.

Where electric bell or annunciator wires are in use the push button telephone can be connected up in a few minutes, using the present system of wiring, batteries, etc. The watch case receiver is of aluminum, making it light and attractive. The push button is of hard rubber.

Fig. 3 shows the telephone with the addition of an intercommunicating plug block. The plug sets into a metal head, thereby insuring a perfect contact at all times. In telephones where the plug is inserted between a metal ring and button, if the wood at any time on which these parts are mounted becomes damp or warped it changes the position of the ring and button, causing the plug to catch in the wood, thus failing to make connections. With the all-metal head this is impossible. The plug is held by a chain, which carries no current whatever, being merely attached to the plug so that it will not get lost. The plug can be left in any jack and any station called, which makes the instrument almost automatic, inasmuch as it is not necessary to return to the home station to receive a call. With this type of telephone, together with a 12-station outfit, six pairs can be talking at one time without interference. Each instrument is equipped with a plug board, making the entire system intercommunicating.

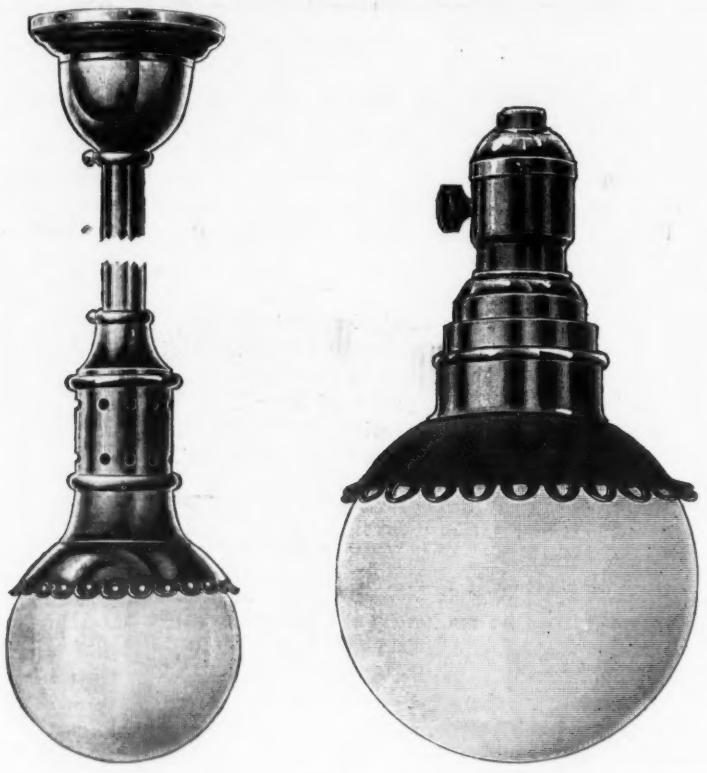


FIGS. 1, 2 AND 3.—PUSH BUTTON TELEPHONE.

Large Incandescent Lamps.

The Electric Appliance Company, of Chicago, is introducing the Zenith incandescent lamp. This lamp is an intermediate between the arc lamp and the incandescent lamp, yet retains the simplicity of the incandescent lamp. It is made in two sizes—25 and 55-cp, at two efficiencies, 1.9 and 2.18 watts.

This new type of incandescent lamp gives a particularly brilliant, yet soft white light, which is evenly distributed beneath the lamp. The range of voltage of this lamp is from 90 to 250, and it is furnished regularly in Edison bases, but can be furnished also with Thomson-Houston base. The fact that it can be used on either alternating or direct current and requires no attention during life, renders it a desirable addition to forms of lighting. A simple collar adapted for use on any style of fixture, or it is furnished complete with ceiling stem, as illustrated.



FIGS. 1, 2 AND 3.—DIFFERENT FORMS OF HIGH CANDLE-POWER INCANDESCENT LAMP.

Jump Spark Plug.

The accompanying illustration shows a jump spark plug manufactured by the Hydra Battery Company, of New York. This type of plug has been manufactured in France at the factory of the French Hydra Company for some time and has been adopted by some of the most noted automobile manufacturers in Europe, many thousands being in use. The American company has imported and sold many of these plugs in this country, and the success met with and the increasing demands for a good plug have led to the erection of a factory in New York, at 70 and 72 Reade Street.

The plug is constructed in one solid body, thus avoiding loose joints. The insulation is the best grade of imported mica washers. The platinum points are extra heavy, and the use of a brass head, prevent rust in the cylinder head. The plugs are manufactured either with the standard American or metric threads.

JUMP SPARK PLUG.

High Tension Cross-Arm and Insulator.

In Fig. 1 is shown a type of pole cross arm which the well-known French firm, E. H. Cadiot & Cie. have applied to several important transmission lines. It will be seen that the cross arm is of metal-iron

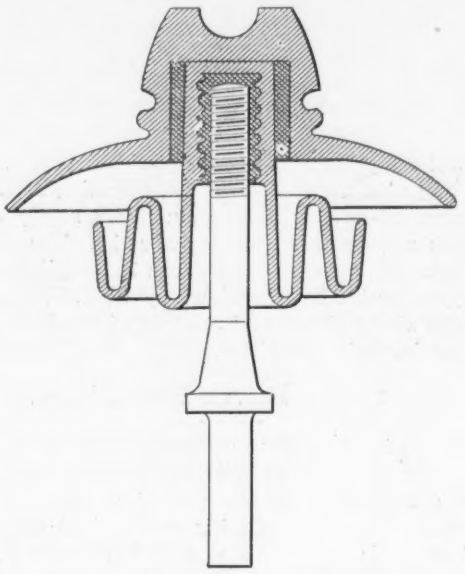


FIG. 2.—HIGH-TENSION INSULATOR.

or steel, and that the insulator pin is secured in a sleeve which latter is then clamped into the end of the arm. The advantages claimed for this system is ease in mounting and in replacing a broken or defective insulator, the additional insulation secured by the use of the sleeve

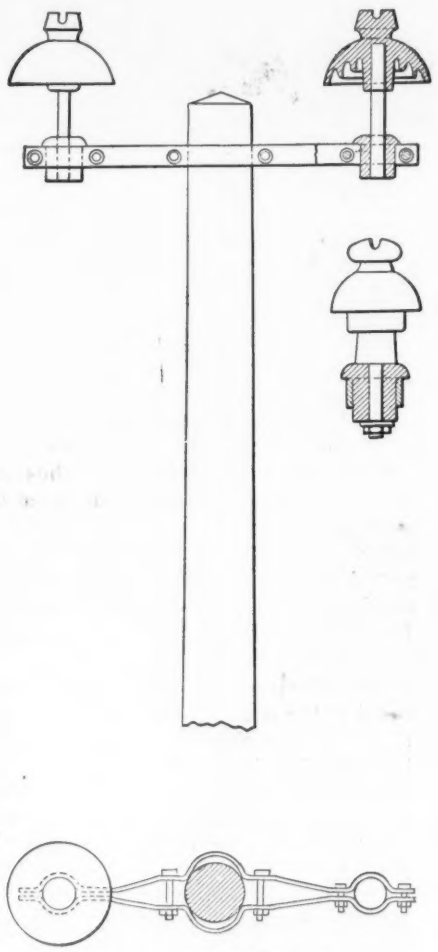


FIG. 1.—POLE CROSS ARM.

as compared with the usual metal cross arm system, and the less area of contact with the pole, and the greater structural strength of the arrangement. Among the recent installations of this type of cross arm is that on the lines of the 15,000-volt Fuilla transmission plant in the south of France (Pyrenees Orientales).

Fig. 2 illustrates a type of high-tension insulator which has been applied by the same firm to a number of transmission lines, and known as the 'Cloche Mehun" insulator. In some tests the leakage at 38,500 volts was only .4 milliampere per insulator. When submitted for 30 minutes to a voltage increasing progressively from 6,500 to 40,500 volts at a frequency of 42 periods, the insulator being plunged in acidulated water, only one broke of a large number submitted to the test.

Porcelain Letter Electric Signs.

An interesting departure in the production of electric lighting signs is shown in the accompanying illustrations, which portray the devices of the Colonial Sign Company, Akron, Ohio, which is now putting on the market porcelain letters for such work.

These letters are made of a perfectly vitreous china with a beau-

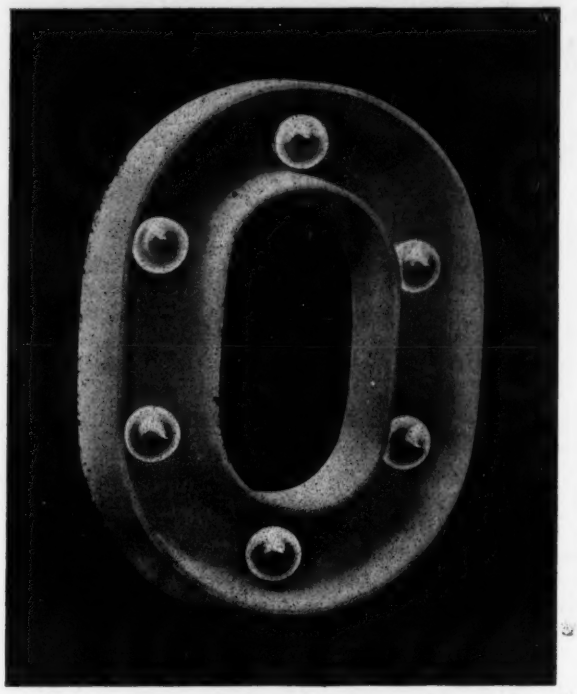


FIG. I.—PORCELAIN LETTER.

tiful non-crazing glaze, in three standard sizes of letters, 12 in., 16 in. and 22 in. Upon removal to its new factory, the company will be able to make any size letter up to 10 ft. high, and will also be equipped to manufacture illuminated porcelain specialties such as trade marks, etc.

Porcelain will appeal to the practical man at once as being an

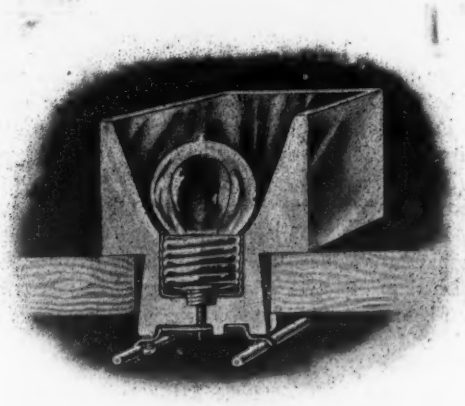


FIG. 2.—SECTIONAL VIEW OF A LETTER.

ideal material for this class of work. It is not affected by heat, moisture, electricity or decay. Once installed, the sign, except for the renewal of lamps, should last a lifetime without further attention. The letters are shaded in any color desired, but thus far the demand has been for a white-faced letter with gold shading. The

colors are burned on the china and are permanent. The letter and sockets are composed of one integral piece of porcelain, and there is no wood or other combustible material in close contact with the lamp or the wiring.

Owing to the shape of the concave face of the letter, the company is able to use fewer and lower candle-power lamps, producing a great saving in operating expense, also a bright, sharply defined

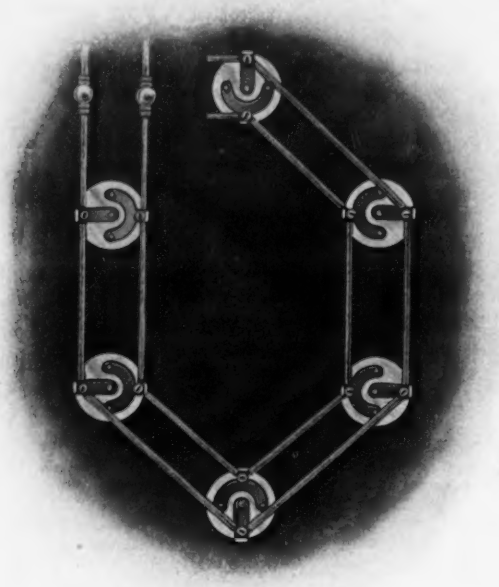


FIG. 3.—INTERIOR CONSTRUCTION OF SIGN.

letter which can be read from a great distance, and at a very acute angle without blurring.

The Colonial Sign Company is building and will shortly move into a new factory in South Akron 160 x 140 in size. This will enable it to handle a rapidly increasing business. The officers of the concern, some of whom are well known in the electrical field, are: H. B. Camp, president; G. P. Good, vice-president; C. R. Quinn, secretary; J. E. Good, treasurer, and G. D. Chapman, general manager.

Mechanical and Electrical Equipment of a Cotton Mill.

The mechanical and electrical equipment of the cotton mills of the Davis Mill Company, at Fall River, Mass., is in many ways exceptionally up-to-date, including a fan-and-heater system of heating and ventilation, induced draft in place of a chimney and electrical motor-drive throughout. To provide flexibility in the boiler plant and insure against shut-down, the induced-draft plant has been installed in duplicate. Two seven-foot blast wheels, running in three-quarter, steel-plate housings, are driven by center-crank, horizontal engines. The fan wheels are overhung in the housings and are furnished with special wide, water-cooled bearings. The engines themselves are provided with extended shafts upon which a pulley is mounted between each fan bearing the respective engines. These pulleys are in reality the flanges of the couplings of the two parts of the shafts, the belts running directly on the flanges. They are used for driving the economizer scrapers.

The air connection between the fans contains a flat swinging damper, which is so arranged that either fan can be shut off and the other run separately if desired. The outlet connections are likewise provided with dampers and the operating attachments are so placed that both can be changed at once by hand. The engines receive steam at 80 pounds and are furnished with a balanced valve, which can be used in connection with a damper regulator.

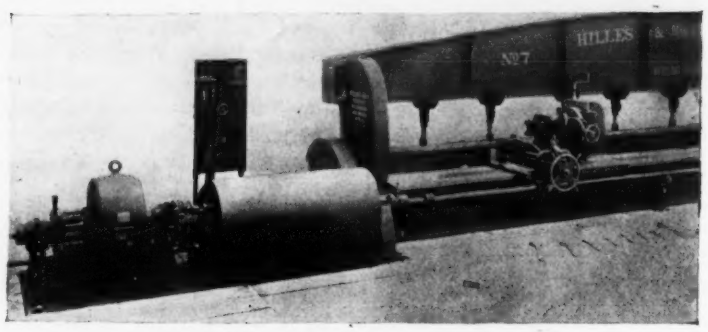
The heating plant of the Davis Mills is a duplicate of that installed at the Arkwright Mills some years ago. It consists of a large exhaust wheel drawing air through a steam pipe heater. The fan wheel is provided with one tight and two loose pulleys and the engine has an extra wide, flat-face, fly-wheel for shifting the belt. A second belt connects the fan pulleys with the line shafting of the mill. This arrangement makes it possible in the summer time to run the fan from the line shaft, thus taking advantage of the economy of the large mill engine, while in the winter when the exhaust of the fan engine can be utilized in the heater, or at night when the large engine is not running, the fan is driven by the fan engine.

The heater is built up of 1-in. pipe erected on cast-iron sections which rest at one end on ball bearings to allow for expansion and contraction. It is so arranged that the exhaust steam from the engine can be used entirely in one group of sections, making it possible to condense all the exhaust before it is necessary to use any direct steam, which is added at a reduced pressure when necessary. The outfit also includes a Kendall receiving tank, with a water-gauge and a safety valve, and a duplex Worthington steam pump. The heating apparatus will heat the mill to 70° F. when the temperature outdoors is zero.

The electrical equipment consists of two belted direct-current generators, one of 50 kw and one of 75 kw, operating at 125 volts, no load and compound-wound. These generators supply current for lighting and for a 27-hp motor and one of 43 hp. The oiling devices of the motors are so arranged that they can be hung from the ceiling. The above apparatus has been furnished by the B. F. Sturtevant Co., of Boston, who also designed and constructed the heating and ventilating and mechanical draft plants.

Electrically Driven Plate Planer.

The illustration herewith shows a 32-ft., heavy plate planer built by Messrs. Hilles & Jones, of Wilmington, Del., and recently installed in the United States Navy Yard at Charlestown, Mass. Direct-connected to the main driving screw of the planer, through gearing and magnetic clutches, is a 50-hp Westinghouse, multipolar



ELECTRICALLY-DRIVEN PLANER.

motor of 220 volts and running at slow speed, which furnishes ample power to enable the machine to plane two-inch armor plate, taking a heavy chip. A thorough test proved the machine to be a powerful tool in every respect.

The saddle of the planer is designed to carry two tools, one cutting in each direction, also a third tool for vertical feed, the saddle and tool holder being shifted automatically at any point desired.

New Cable Bracket Frame.

CABLE BRACKET FRAME.

In the accompanying illustration is shown the Gest bracket frame being placed upon the market by G. M. Gest, of Cincinnati and New York. The frame is made of angle iron heavily galvanized. It is sup ported at top and bottom with anchors which with the frame itself are built in the wall, the face of the frame being flush with the wall, thereby taking up no room in the manhole.

The cable bracket, of galvanized cast iron, is secured to the frame by means of a galvanized T-head bolt with a special nut so designed that the bracket is removed by being lifted straight up. By means of this nut the bracket can be adjusted to any angle and as the slot in the frame is unobstructed from top to bottom the bracket can be adjusted to any height desired.

The frames are made in the following lengths: 12-in., 24-in., 30-in., 36-in., 42-in., and the brackets are made in three sizes—single, double and triple. Longer frames than the above are made to special order. The brackets and bolts are removable at any time and very little time is required to change from a single bracket to a double or triple type. All parts being heavily galvanized, they will last as long as the conduit system itself.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money closed quiet and was offered with considerable freedom, the rates being 4½ per cent. for 30 to 90 days, and 4¼ to 4½ per cent. for four to six months' time. The stock market was dull, and showed a tendency toward lower prices at the end of the week. The public participated in the market very slightly. The labor situation is still deemed an uncertain element, although no change or improvement has taken place in that respect during the week. Neither is there any material alteration in the position of the iron industries. United States Steel securities showed considerable strength without any advance in their prices. In the industrial group one of the few important movements was in Brooklyn Rapid Transit, which was very strong, and rose to 59½ on buying, this being accompanied by confident reports from inside sources about the large traffic and earnings of the system. Outside support was lacking, however, and the stock receded later in the week. This stock closed at 58, thus gaining 2 points net over the quotations of the previous week. Metropolitan Street Railway showed a little more firmness and made a net gain of 1 point, closing at 123 after having touched 122¼. In the electric list General Electric closed at 179, the range of prices being between 178 and 180. One thousand two hundred and twenty-five shares of this stock changed hands during the week. Westinghouse closed at 190, which was the ruling figure throughout the week, and Western Union Telegraph closed at 85⅜, being a net gain of ⅞ of a point. American Telephone and Telegraph rights closed at 6⅛—⅛ of a point higher for the week. Amalgamated Copper was largely manipulated but showed a tendency to sell off in sympathy with adverse reports about the condition of the copper market. Following are the closing quotations of July 7:

NEW YORK.

	June 30.	July 7		June 30.	July 7
American Tel. & Cable	80	80	General Electric	179	..
American Tel. & Tel.	134	131	Hudson River Tel.	..	..
American Dist. Tel.	30	30	Metropolitan St. Ry.	123¼	123⅜
Brooklyn Rapid Transit	57½	57⅝	N. E. Elec. Veh. Trns.	..	..
Commercial Cable.	162	..	N. Y. & N. J. Tel.	112	..
Electric Boat	17	17	N. Y. E. V. T. Co.	5⅛	5⅛
Electric Boat pfd.	40	40	Tel. & Tel. Co. Am	..	..
Electric Lead Reduction.	1	1	Western Union Tel.	85	..
Electric Vehicle	6⅛	7⅛	Westinghouse com.	190	..
Electric Vehicle pfd.	13	13⅛	Westinghouse pfd.	190	..

BOSTON.

	June 30.	July 7		June 30.	July 7
American Tel. & Tel	134¼	132	Western Tel. & Tel. pfd.	90	90*
Cumberland Telephone	..	..	Mexican Telephone	1⅝	1⅝
Edison Elec. Illum.	..	..	New England Telephone	125½	129
General Electric	..	..	Westinghouse	93	..
Western Tel. & Tel.	12	13	Westinghouse pfd.	93	..

PHILADELPHIA.

	June 30.	July 7		June 30.	July 7
American Railways	45	..	Phila. Traction	95¾	95¾
Elec. Storage Battery	60	60	Phila. Electric	6¾	6⅝
Elec. Storage Battery pfd.	60	..	Pa. Electric Vehicle	..	..
Elec. Co. of America.	8¾	8⅞	Pa. Electric Vehicle pfd	..	..

CHICAGO.

	June 30.	July 7		June 30.	July
Central Union Tel.	..	..	National Carbon pfd.	93	93
Chicago Edison	150	..	Northwest Elev. com.	..	..
Chicago City Ry.	190	190	Union Traction	3¼	4
Chicago Tel. Co.	125	..	Union Traction pfd.	30	30
National Carbon	22	23			

*Asked.

CONSOLIDATION IN ST. LOUIS.—With the passing of the Missouri-Edison Electric Company into the hands of the North American Company of New York, a plan is reported for the consolidation of all the electric-power companies with the street railways of St. Louis, into one gigantic corporation, with a capital of $141,000,000. For the re-organized Missouri-Edison Company William F. Nolker, a director in the Missouri Valley Trust Company, was elected president, and August Gehner, also a director in that institution, was made vice-president. The new directors are Charles H. Huttig, H. C. Stifel, C. Marquard Firster, E. H. Benoist, Philip Stock, Henry Semple Ames, William D. Orthwein and Messrs. Gehner and Nolker. The reorganization is a temporary one, it being the intention of the new owners of the property to consolidate with the Union Electric Light and Power Company. A special stockholders' meeting of the Missouri-Edison will be advertised without delay, so the consolidation can be effected not later than September. J. Pierpont Morgan, who dominates the North American Company, is said to be the moving spirit in the proposed consolidation. That company recently purchased the Laclede Gas Light Company, and it owns the controlling interest in the Union Electric Light and Power Company. The Union Electric Light and Power Company has in course of erection a $6,000,000 plant, located at the foot of Biddle Street. This plant will have a capacity of 25,000 kw, and will, when completed, be one of the largest electric power plants in America. The company has a contract with the World's Fair Company to furnish light and power during the Exposition period. The contract is for not less than 7,500 kw, to be supplied at a minimum cost of $338,976. The power for this contract will be supplied by the new plant. At the close of the Exposition this surplus power will be for sale to consumers generally. Among the consumers who will be customers of the Union Company after the World's Fair will be the St. Louis Transit Company. That company, it is said, will purchase in the neighborhood of from 15 to 20 per cent. of its power from the lighting company. All the old directors and executive officers of the Missouri-Edison retire with the acquisition of the company by the reorganized concern. There will be no change, it is said, in the operating officers and employees. The power-houses of the company will continue in operation, as heretofore. The terms of the purchase, as was announced recently, are: $55 for the preferred and $25 for the common stock. All stockholders of the company have an opportunity to dispose of their holdings at these figures. The new owners have purchased something more than 85 per cent. of the stock.

MICHIGAN TELEPHONE.—At the recent annual meeting of the Michigan Telephone Company Vice-President H. J. Pettingill presided. The number of shares represented, either in person or by proxy, was 39,112, and there was no opposition to the re-election of the old board, as follows: Philip Dexter, Frederick P. Fish, W. S. Hutchinson, H. J. Pettingill, Hugh McMillan, Thomas Sherwin and Dudley E. Waters. The business of the meeting, what little there was transacted, was practically directed by George V. Leverett, of Boston, general counsel for the Western Telephone Company. The report of the treasurer showed that the earnings of the company for 1902 were $1,549,531. The expenses for the same period were $1,632,230, leaving a deficit of $82,699. The total deficit of the company as shown by the ledger balances December 31, 1902, amounts to $501,296. Loans and accounts payable on the same date amounted to $2,538,176. No salaries are being drawn by the executive officers now, and the entire purpose of the meeting, as stated by Mr. Leverett, was to keep the organization going, and to have officers to represent it in court. All debts for labor and material, for which the stockholders would be individually liable, were paid up to the time the receiver was appointed. The motion was made to approve all the acts of the board of directors and executive committee for the past year. Objection was made, and the secretary was compelled to read the entire records from the time the directors met in Boston after the last annual meeting for organization. Those in control of the meeting, however, had the votes, and the acts were ratified. No one was present to represent the Union Trust Company as receiver.

PORCHESTER (N. Y.) ELECTRIC ROAD.—The New York Court of Appeals handed down a decision upholding the permission granted by the State Railroad Commission to the Port Chester Electric Railroad Company to construct its road from the Harlem River through Westchester County to Mount Vernon, New Rochelle and Port Chester. The new company is to construct a third rail surface road to connect with the rapid transit underground road. The New York, New Haven & Hartford Railroad Company opposed the construction of the Port Chester road on the ground that no public necessity demanded it. Mr. August Belmont, president of the Interborough Rapid Transit Company, has emphatically denied that his company is in any way interested in the Port Chester Railroad Company, rumors to that effect having been in circulation. This is the road with which Mr. C. O. Mailloux and Mr. W. Gotshall are so prominently connected.

PARIS GAS PLANT.—A cable dispatch from Paris, of July 3, says: The Municipal Council to-night, after a discussion which has occupied the main part of the last few sessions, finally rejected all propositions to grant concessions for the supply of gas in the City of Paris to foreigners, notably the so-called American scheme of Devaleuz and Duchaney, who it is alleged, represented Anthony N. Brady, the American capitalist, which proposition was strongly indorsed by the committee which inquired into the matter. The opponents of the scheme urged that it would really place a monopoly of the supply of gas and electricity in Paris in foreign hands, and they pointed out that the guarantees offered while being nominally $6,000,000, in reality only amounted to $2,000,000. After rejecting the American proposition the Municipal Council decided on a municipal monopoly of gas, the city to manufacture gas on its own account and reap the whole profits on its sale to consumers.

DIVIDEND.—The Electric Company of America has declared the regular semi-annual dividend of 30 cents per share out of the earnings for the six months ending June 30 last. The dividend, which is at the rate of 6 per cent. per annum, is payable July 31 to stockholders of record July 20.

NASHVILLE RAILWAY AND LIGHT.—It is stated that the Nashville Railway and Light Company has filed articles of incorporation with the Secretary of State of Tennessee, and has been given authority to issue $6,500,000 stock.

Commercial Intelligence.

THE WEEK IN TRADE.—The warm weather improved the general situation and induced favorable conditions for the winter wheat harvest; helped corn and cotton, and enlarged the retail trade in summer goods. Altogether there is a much more cheerful feeling as to the outlook for business generally. Additional reports as to six months' trade are quite favorable, despite earlier unfavorable conditions. Farm products show a general downward tendency, though uncertainty as to the real condition of the cotton corner clouds this particular situation. Some revival in export trade is reported as a result of the price reaction. In the iron and steel trades there were few developments, a slightly better feeling being noted. New buying is still small though better than for some weeks past. The placing of large rail orders, 500,000 tons in all, for next year lends confidence to the situation. Foreign iron and steel are apparently out of the market to stay. Hardware is in better demand, though not so good as a year ago, but manufacturers are reported to have agreed to maintain prices at last year's rates. Copper was weak, with rumored sales at ¼c. reduction, and the demand was extremely light. Official prices are unchanged, both Lake and electrolytic being quoted at 14½c. and casting at 14c. The business failures for the week ending July 2, according to *Bradstreet's*, numbered 162, against 171 the week previous and 138 the corresponding week last year. The failure returns for the first six months were, according to the same source of information, the smallest in number reported in 20 years, though a comparatively few large suspensions, unrelated to one another, swell liabilities to 5 per cent above those of last year.

BELLEVILLE PORTLAND CEMENT COMPANY.—A novel application of induction motors is to be made by the Belleville Portland Cement Company in its current plant at Belleville, Ont., which is to be equipped throughout with electrical apparatus. A recent order placed with the Westinghouse Electric & Manufacturing Company comprises two 450-kw, engine--type alternators, one 100-kw, direct-current, engine-type generator and a motor-generator set consisting of a 100-kw, direct-current generator, and a 150-hp, three-phase induction motor. These two direct-current machines are to be used for exciting the fields of the alternating-current generators, for supplying lighting circuits and for the operation of a tramway locomotive. Sixty-two induction motors will supply the motive power. These include forty-six constant speed motors, ranging in capacity from 10 to 50 hp; ten variable speed induction motors, each to be direct-geared to a rotary kiln and provided with a controller permitting the operation of the motor at any one of four speeds; two type F motors, each to be direct-connected to a hoist and provided with standard non-reversing hoist controller; also four 400-volt, variable-speed induction motors for the operation of two overhead traveling cranes, these being provided with reversible crane controllers. Included in the equipment is a Baldwin-Westinghouse mining locomotive for operation on a 24" gauge track with double trolley. Altogether this will be a novel and interesting plant, as the operation of rotary kilns by direct connection to variable speed induction motors is a new departure from the usual method of supplying power to this class of machines.

KELLER, PIKE & CO., Philadelphia, Pa., have been awarded the contract for the entire electrical equipment in the new Pennsylvania State capitol building, at Harrisburg, Pa. This contract covers six engines, aggregating 1,200 hp, six direct-connected generators amounting to 800 kw, a white Italian marble switchboard, consisting of twelve panels with Weston instruments and Cutter circuit-breakers, electric wiring for motors aggregating 200 hp, and over ten thousand incandescent lamps. It also includes an annunciator system, connecting each member of the Senate and the House with a central station, and another system connecting the head of each department with the subordinates, as well as a telephone exchange connecting the governor with the heads of the twenty departments, the president of the senate with twenty committee rooms, and the speaker of the house with forty committee rooms. All the rooms in the building are also connected by a telegraph system with a central office. This contract makes a notable addition to the already extensive list of important installations of Messrs. Keller, Pike & Co., which includes among others, the National Export Exposition, the U. S. Mint, of Philadelphia, and the department store of Gimbel Brothers.

SOLVAY EXTENSIONS.—Westinghouse, Church, Kerr & Co. have recently received orders for additional boiler and economizer equipments for the Detroit plant of the Solvay Process Company. The Solvay Company operates at Detroit, and Syracuse, N. Y., two of the largest chemical establishments in the United States. The Detroit plant is located at Delray, a suburb on the Detroit River, and near the enormous salt deposits occurring in the marshland at this point. Steam power is furnished from a central boiler plant, which at present aggregates 7,200 hp. Roney mechanical stokers are used throughout, and the several batteries of boiler are also equipped with Roney high-pressure, circulating type economizers. The plant is laid out in batteries of six boilers each. The additional equipment will consist of a new battery, comprising six 300-hp Babcock & Wilcox water-tube boilers, fitted with Roney stokers, together with four additional economizers, two of which will complete the equipment of a previously installed battery. A conspicuous feature of this plant is a massive brick stack 16 feet in diameter and 260 feet in height.

CARS FOR BROOKLYN.—The Brooklyn Rapid Transit Company is in the market for 200 closed cars, which involves an expenditure of about $500,000. The Brooklyn system has been adding materially to its equipment during the past few years, and is getting in position to handle the increased traffic which it will have to contend with when the new bridge is opened to New York. The Brooklyn Rapid Transit Company intends to make extensive improvements during the present year, and $14,008,719.73 has been appropriated for this purpose. Of this amount $6,000,000 is to be used for a new power-house on Kent Avenue, with a capacity of 80,000 horsepower; $3,124,962 is to be expended in the enlargement of other power-houses; $1,821,500 for the improvement and equipment of the elevated and surface lines; $1,295,935 for miscellaneous work, including new tracks and new buildings; $1,153,823 for the construction of underground conduits for carrying feeder cables, and $612,500 for the purchase of real estate.

BIDS WANTED AT MINNEAPOLIS.—Five of the prominent implement and machine jobbers of Minneapolis, Minn., whose buildings are located in close proximity, are figuring on the advisability of putting in a joint plant for the purpose of heating, lighting and furnishing power for their buildings. Four of these buildings are each seven stories high, and the fifth is five stories high. They are occupied by the Advance Threshing Machine Company, J. I. Case Threshing Machine Company, J. I. Case Implement Company, Bement-Darling Company, and Adland Transfer and Storage Company. Parties wishing to figure on this installation may address their communications to the J. I. Case Implement Company, 622-628 South Third Street, Minneapolis.

FIRE IN MANHATTAN SHOPS.—On July 4 a costly fire occurred in the shops of the Manhattan Elevated Railway Company between Ninety-eighth and Ninety-ninth Streets and Lexington and Park Avenues. In the buildings were about fifteen new cars, valued at $6,000 each, and the ten motors worth $3,300 each. These were destroyed, together with about $4,000 worth of mill work and a large number of valuable plans and the two center buildings, making a total estimated loss of about $150,000. The only cause suggested for the fire is that rockets may have been shot through the open skylights. No work of any kind was going on.

THE HAMMOND PACKING COMPANY has abandoned its plant at Hammond, Ind., having spent over a million dollars in the construction of a fine, new plant at the Union Stock Yards, Chicago. The new offices are lighted by three and six-glower Nernst lamps, sold through the Chicago sales office of the Nernst Lamp Company, and it is stated that a large additional number of these lamps will soon be installed in its extensive packing house.

NEW YORK CENTRAL CHANGE.—At a meeting last week of the directors of the New York Central and Hudson River Railroad Company, and also at a meeting of the directors of the New York and Harlem Railroad Company, the agreement with the city for depression of tracks in the Grand Central yards and for changes from steam to electricity as a motive power was approved, and the contract has now been executed.

H. O. S. ENGINEERING COMPANY, 88 Warren Street, New York, reports its business as steadily increasing in the switchboard and panelboard field. It has recently received orders for the switchboard for the United States Mint, Denver, Colo.; panelboards for the Navy Yard, Brooklyn, N. Y.; panelboards for the Lyric and Metropolitan theatres, New York City, and panelboards for the Hotel Victoria, New York.

General News.

THE TELEPHONE.

STERLING, ILL.—The Interstate Telephone Company is making preparations to build a toll line to Prophetstown.

WAVERLY, ILL.—The capital stock of the Waverly Telephone Company has been increased from $5,000 to $35,000.

ROANOKE, ILL.—The Local Telephone Company has been organized here. J. R. Claudin is president and H. D. Hollenbeck secretary.

BERWICK, ILL.—The A. B. C. Telephone Company has been incorporated, capital stock, $2,000. Incorporators: L. H. Robertson, Thomas Meadows, C. L. Miller.

CHICAGO, ILL.—The council committee on gas light and electric light has recommended for passage the ordinance asked by the United Telegraph, Telephone & Electric Company, by which that company can extend its service to all parts of the city. It now has a small exchange in the district known as Hyde Park.

MOORESVILLE, IND.—The Mooresville Home Telephone Company has increased its capital stock from $10,000 to $25,000. The company proposes to extend its line and service to Edgerton, and make other extensions.

CONVERSE, IND.—A stock company composed of business men has been organized with a capital of $25,000 to purchase and operate the Converse telephone plant, owned by H. S. Bowers. The price paid is $8,000. The telephone lines will be extended and the plant otherwise improved.

INDIANAPOLIS, IND.—The strike among the local telephone linemen has assumed a serious phase. For four weeks they have held out and commanded the field against all comers. Last week the telephone companies procured police powers for a number of "watchmen." These "watchmen" turned out to be electricians and were put to work stringing wires and repairing telephones. The strikers are alleged to have assaulted a workman who resisted by using his revolver. A striker was shot in the shoulder. The police powers have been revoked and the whole matter submitted to labor commissioner McCormack, who will endeavor to bring about a settlement of the trouble.

WABASH, IND.—After twenty-five years of service in this city the Central Union Telephone Company has abandoned the local field. The company's franchise expired by limitation a few days ago and no new application for a renewal was made. The business of the company has dwindled until the plant was operated at a considerable loss each year, the Home Telephone Company taking practically all the valuable connections. When the Home Company's independent service was established seven years ago, the Central Union gave service substantially free, but in spite of the free competition the independent company thrived and a year or more ago the Central Union returned to the old rates, which are 50 per cent. higher than its competitor's, with the result that it got no new business and lost nearly all of the old. It is semi-officially announced that the company will maintain a toll station here.

CHICKASHA, I. T.—The El Reno & Topeka Telephone Company, which has just absorbed the Chickasha local exchange and toll line system, will make many improvements. A new distributing board, new cable to all terminals, new toll line board and a metallic circuit to Anadarko will be put in at once. W. D. Devarney, general superintendent, will remain in charge for the present.

ANITA, IA.—The Rural Telephone Company has purchased the line of the Musson Brothers.

CRESTON, IA.—The Creston Mutual Telephone Company has increased its capital stock to $100,000.

CHARTER OAK, IA.—A new telephone company has been formed here with a capital of $10,000.

DALLAS CENTER, IA.—The Farmers' Telephone Company has been incorporated with a capital stock of $20,000.

WASHINGTON, IA.—The Washington Telephone Company, L. D. Robinson, president, has been incorporated with a capital stock of $50,000.

WICHITA, KAN.—The Wichita Independent Telephone Company has been incorporated, among the directors being F. L. Brown. The capital stock of the company is $200,000.

NICHOLASVILLE, KY.—The Jessamine Telephone Company has been incorporated with a capital of $30,000.

VERSAILLES, KY.—The Cumberland Telephone & Telegraph Company has applied for a telephone franchise in this place.

WHITESBURG, KY.—Citizens of this town are organizing the Whitesburg Telephone Company and will install a local exchange at once.

CORUNNA, MICH.—The Laingsburg Telephone Company has been incorporated with a capital stock of $2,500.

BAINBRIDGE, MICH.—The Bainbridge Telephone Company with a capital stock of $2,000 has been incorporated.

WATERLOO, MICH.—The Rural Telephone Company has a 100-drop board and 265 subscribers at $12 per annum.

SAUGATUCK, MICH.—The Saugatuck & Gauger Telephone Company operates four boards of 50 drops each and one of 75. The subscribers number 190.

JACKSON, MICH.—The Citizens' Telephone Company operates 1,650 drops of a 3,000-drop switchboard; has 1,950 subscribers and 75 miles of toll line. Rates are $30 and $18.

PLYMOUTH, MICH.—The Plymouth Telephone Company has outgrown its capacity and will soon install a large board. It will soon have connection with every independent line in the state. There is now a 120-drop board, 155 subscribers, two toll lines, 20 miles of farmers' lines and more projected.

KIBBIE, MICH.—The Kibbie Telephone Company is just finishing a toll line connecting its system with Schoolcraft. It has a fine new office at Paw Paw with over 200 subscribers. A new switchboard is ordered for this place which has between 700 and 800 subscribers and 300 miles of toll line. Rates are $15.

IRON MOUNTAIN, MICH.—The Menominee Range Telephone Company is extending a copper metallic line to Pembine, Wis., to meet the Wausaupee Telephone Company and get service to Menominee, Mich.; Marietta and Green Bay, Wis., a distance of 90 miles. The company has a 300-drop board, 580 subscribers and 45 miles of toll line. It has 11 exchanges and two toll stations.

ST. JAMES, MINN.—A telephone franchise has been granted here to the Minnesota Valley Telephone & Telegraph Company.

MAZEPPA, MINN.—The Mazeppa Telephone Exchange, owned by Mr. J. W. Kingsley, has a 100-drop board and 50 subscribers.

WASECA, MINN.—The Waseca Telephone Company operates a 200-drop Kellogg board, with 178 subscribers and 15 miles of toll line.

MANKATO, MINN.—The Citizens' Telephone Company will construct a line from here to St. Clair and from Lake Washington to Madison Lake.

FRANKLIN, MINN.—The Franklin Local & Rural Telephone Company has been incorporated with a capital stock of $15,000, by H. B. Cole and others.

HENDRUM, MINN.—The Hendrum Telephone Company has been incorporated with a capital stock of $5,000, Mr. V. H. Moffatt being among the directors.

HASTINGS, MINN.—The Hastings Telephone Company has a 200-drop board, 220 subscribers and 15 miles of toll line, the rates being $1 and $2 per month.

LAKE CITY, MINN.—Mr. G. M. Dwelle expects to add 150 new subscribers during this summer to his rural service in the towns of Glasgow, West Albany and Lake.

CHATFIELD, MINN.—The Peoples' Telephone Company has 28 subscribers and many miles of toll line in several directions, besides connecting with the lines of other companies.

LONG PRAIRIE, MINN.—Minnesota Central Telephone Company operates a 150-drop board and has 116 subscribers. There are 2,000 miles of toll line and great improvements are contemplated. Metallic circuits will be built.

AUSTIN, MINN.—The Interstate Telegraph & Telephone Company is just commencing to build a full cable system; no bare wires to be in the city. It will install a central energy switchboard capable of taking care of 1,600 subscribers and will connect with many small towns.

GRAND MEADOW, MINN.—The Home Telephone Exchange which is owned and managed by Mr. C. F. Greening operates a 100-drop board and 200 subscribers. There is more demand for extensions than can be furnished, but it is the intention to cover this territory thoroughly. Farmers are very anxious for service. Rates are 10c. for five minutes, $12 per year.

MINNEAPOLIS, MINN.—The Twin City Telephone Company has 33,600 switchboard capacity, 9,500 subscribers and 500 miles of toll line. Rates are $30 and $48. This company is growing steadily at the rate of 300 subscribers per month, and is building toll lines in this state. It expects to build main trunk lines in Minnesota, North and South Dakota in the next two years.

HOUSTON, MISS.—This station is owned by Messrs. Williams Bros. It has a 25-drop board with six subscribers and 70 miles of toll line.

TUPELO, MISS.—The Amory & Tupelo Telephone Company has been incorporated with a capital stock of $10,000. Mr. R. E. Camp is one of the directors.

OXFORD, MISS.—The Oxford Telephone Company operates a 225-drop board and has 210 subscribers with 25 miles of toll line. The entire system was rebuilt last year.

PONTOTOC, MISS.—The Alabama, Mississippi & Tennessee Telephone Company has all its lines grounded. There is a 100-drop board, 70 subscribers and 140 miles of toll line.

LEXINGTON, MISS.—The Lexington Improvement Company is now putting in a new cable. That it is prospering is evidenced by the fact that a ten per cent. dividend was declared at its recent meeting.

MACON, MISS.—The Macon Electric Telephone & Water Works Company has just begun operations under a new ownership. The switchboard capacity is 100 drops. It has 95 subscribers and 500 miles of toll line, with 200 miles more projected.

BOONEVILLE, MISS.—The Booneville Electric Light & Power Company operates a 100-drop board with 258 subscribers and 156 miles of toll line. The company expects to double its system this year owing to the great demand for telephones.

YAZOO CITY, MISS.—The Mutual Telephone Company operates a Kellogg 400-drop board and 460 subscribers. It owns 100 miles of toll line and has 350 outside, besides 100 more projected. The company is very prosperous and has large territory to work over.

COLUMBUS, MISS.—The Citizens Tel. & Tel. Company operates in Columbus and Aberdeen with a 400-drop capacity in Columbus and 200 in Aberdeen; and 398 and 235 subscribers respectively, with 320 miles of toll line. Extensions to Memphis, Tenn., and Birmingham, Ala., are projected. The Columbus company connects with other independent exchanges within a radius of 60 miles and a number of farmers' lines.

EDINA, MO.—Mr. E. B. Berberet operates the exchange here. He has a 200-drop board and 115 subscribers, with 11 miles of toll line.

FAIRFAX, MO.—The Fairfax Telephone Company operates a 200-drop board has 350 subscribers, and is about to build 175 miles of party lines.

FREDERICKTOWN, MO.—The Citizens Telephone Company operates a 225-drop board, has 200 subscribers and 40 miles of toll line. Rates are 15c. and 25c.

BOWLING GREEN, MO.—The Bowling Green Telephone Company has a 250-drop board, with 200 in use. There are 190 subscribers at $12 and $24 per year.

ELY, MO.—Sidney Corder is one of the directors of the Union Valley Telephone Company, which has been incorporated here with a capital stock of $3,600.

KEARNEY, MO.—The Stromberg-Carlson Telephone Manufacturing Company has recently sold the Kearney Telephone Company, of Kearney, Mo., a 100-drop switchboard and 200 telephones.

EVERTON, MO.—Nearly all farmers in this district have a telephone in their houses. The Everton Telephone Company operates a 100-drop board, has 50 subscribers and 25 miles of toll line. A new exchange is to be built.

CALIFORNIA, MO.—The California Telephone Exchange has a 250-drop board, 175 installed and 175 subscribers. There are 100 miles of toll line. The Kinloch system of St. Louis is building a trunk toll line through here.

CLINTON, MO.—The Missouri Union Telephone Company operates a 500-drop board in Clinton, 200 in Windsor, 550 subscribers in the former, 250 in the latter place. A new 600-drop board is to be put in, also 6,000 feet of cable.

HUNTSVILLE, MO.—The Huntsville Telephone Company operates 250 drops of a 300 capacity switchboard; has 214 subscribers and 25 miles of toll line. This company has been steadily increasing since it commenced operations three years ago.

EXCELSIOR SPRINGS, MO.—The Citizens Telephone Company has 400 switchboard capacity, 370 installed, 362 subscribers and 65 miles of toll line. Five hundred additional telephones are to be installed. Fifty miles of metallic toll lines are under construction. The charge is $1.50 per month, 10 telephones to the line.

BOLIVAR, MO.—The McKee-Drake Telephone Company and the Bolivar Exchange are both the property of Mr. J. C. McKee. A 220 drop board supplies service to 100 subscribers of the former and 400 of the latter. An increase of 100 miles is projected by the company and 20 more subscribers are to be added at once.

CALHOUN, MO.—The Tebo Telephone Company operates a 100-drop board, has 90 subscribers at $9 to $12 and has recently added farmers' lines with 15 subscribers. The company intends building a toll line to Thrush, a neighboring village, and installing an automatic switch to connect several farmer lines at $12 per year.

WINDSOR, MO.—The Missouri Union Telephone Company has exchanges at Windsor, Calhoun and Clinton. Extensive farm line connections are being made in Henry, Johnson and Benton counties. The farmers pay an installation fee of $25 and $1 per month afterwards. There is a 200-drop board here, with 250 subscribers and 100 miles of toll line.

BUTLER, MO.—The proprietor of the Butler & Rich Hill Telephone Exchanges operates a 300-drop board at the former place and 200 at the latter. There are 395 subscribers, 77 miles of toll and farmers' lines. Mr. Reinheimer proposes using $25,000 for building up the systems and will have long distance connection with the Kansas City independent system, which again will give connection with Chicago, St. Louis and all eastern cities.

BOZEMAN, MONT.—The West Gallatin Telephone Company has 15 miles of toll line and 15 subscribers. This line is connected with the Rocky Mountain Bell Company.

LEWISTON, MONT.—The Lewiston Telephone Company handles also the business of the Lewiston & Grass Range Telephone which has 12 stations. The former operates a 200-drop board with 165 subscribers, has 240 miles of toll line with 37 offices.

YORK, NEB.—The York Independent Telephone Company has increased its capital stock from $50,000 to $500,000.

ST. EDWARD, NEB.—The Shedee Independent Telephone Company has been incorporated in this place with a capital stock of $10,000.

ALBION, NEB.—The Albion Telephone Company operates a 200-drop board, has 200 subscribers and 16 miles of toll line. Improvements are projected.

BROKEN BOW, NEB.—The Central Telephone Company operates a 260-drop board, has 275 subscribers and 700 miles of toll line. Farmers rates are $1 per month. A new exchange at Ansley has just been completed and many farmers' lines are being constructed.

PLATTSMOUTH, NEB.—The Plattsmouth Telephone Company has 1,000 subscribers and 175 miles of toll line. An increase of line into Lincoln, Neb., is projected. There is a great demand for independent telephone systems in this state and Iowa. Omaha and Council Bluffs offer attractive conditions to large independent systems.

CHADRON, NEB.—Mr. W. T. Wilson informs us that he started his line four years ago. This season he has built 100 miles of toll line and expects to build 75 more. He cannot supply the farmers' demands fast enough. The Chadron Telephone Company, of which he is owner, has developed into a fine property; operates a 100-drop board with 150 subscribers and has 340 miles of toll line.

ROSWELL, N. M.—The Roswell Telephone & Mfg. Company operates a 400-drop board and 300 subscribers, 10 long distance, with 35 miles of toll line.

CARLSBAD, N. M.—An electric power, light and telephone system is operated here. The latter has a 200-drop board and 140 subscribers; 40 miles of copper line and 65 miles of fence line. More toll lines are projected.

SCOTCHTOWN, N. Y.—The Citizens' Telephone Company has a three-drop board, 18 subscribers and 15 miles of toll line.

CORINTH, N. Y.—The Corinth Telephone Exchange operates a 60-drop board and has 78 subscribers at $15 and $18 per year.

HANCOCK, N. Y.—The Kelsey & Bannersville Telephone station has a five-drop board and 18 subscribers with five miles of toll line.

PENN YAN, N. Y.—The Friend Telephone Company has been incorporated with a capital stock of $5,000, among the directors being J. K. McConnell.

WAYNE, N. Y.—The Wayne Telephone Company is a short connecting link with Keuka on the Bell line. It has two miles of toll line and 11 subscribers.

SCHROON LAKE, N. Y.—The Schroon Lake & Crown Point Telephone Company operates a 60-drop board, has 100 subscribers and 40 miles of toll line. Rates are $12 and $18.

DOWNVILLE, N. Y.—The East Branch Telephone Company has 36 subscribers and 38 miles of toll line. This company was organized for the accommodation of the stockholders and will pay about six per cent. on the investment.

ARCADE, N. Y.—The Wyoming & Cattaraugus Telephone Company operates a Eureka 50-drop board and has 185 subscribers and 18 miles of toll line. It has just closed a contract with the Inter-Ocean Telephone & Telegraph Company of Buffalo for outside connections, and toll service into Buffalo and other points.

WELLSVILLE, N. Y.—The Wellsville Telephone Company has just installed a new switchboard, common battery system which is giving very satisfactory service. There is a 200-drop board supplying 235 subscribers and connection is made with the Inter-Ocean Tel. & Tel lines. Rates are $20 and $12 The subscription list is growing rapidly.

CANANDAIGUA, N. Y.—The Peoples' Telephone Company has increased its capital stock from $8,000 to $25,000. The additional capital will be used in extensions along the shore of Canandaigua Lake and into the towns of Gorham and Hopewell. At the recent meeting of the company, officers were elected as follows: President, H. W. Blake; vice-president and superintendent of construction, John Litzendorf; secretary, G. B. Hemenway.

WAYLAND, N. C.—The Wayland Independent Telephone Company operates a 100-signal 12-bell switchboard; has 100 subscribers and 10 miles of toll line. It has a common battery system.

ELIZABETH CITY, N. C.—The Norfolk and Carolina Telegraph & Telephone Company operates 135 miles of toll line at an average rate of 25c., and is now constructing a 50-mile extension. The company was formed in 1902 to take over the properties of the Camden Telephone Company and the Portsmouth & Cornland (Va.) Telephone Company. Since then it has increased the former 30 miles; extended circuits to Edenton (30 miles) and will soon complete to Moyock (30 miles).

WALHALLA, N. D.—The Northwestern Telephone Company will extend its lines from Langdon to Hanna.

CASSELTON, N. D.—Mr. C. R. Meredith started a telephone line here three years ago with 44 instruments. Now there are 200 subscribers getting service from a 150-drop board and 40 miles of toll line. Rates are $1.50 and $2.

HELENA, OHIO.—The Helena Telephone Company has a Eureka 50-drop board and 100 subscribers.

FITCHVILLE, OHIO.—The Clinton Air Line Telephone Company has been incorporated by S. M. Sly and others, with a capital stock of $6,000.

OXFORD, OHIO.—The Oxford Telephone Company has secured a franchise for four lines to extend from Oxford to Collinsville, Jacksonboro, Somerville, Reiley and Hamilton.

SPRINGFIELD, OHIO.—The United States Telephone Company is building new long distance lines between Kenton and Springfield. The new exchange in Springfield will be ready for operation in the near future.

CINCINNATI, OHIO.—The United States Telephone Company is extending its long distance lines to the city limits of Cincinnati. This is taken to indicate that the independent people have strong hopes of building an exchange in the city in the near future.

ALBANY, OHIO.—The Albany Home Telephone Company operates a Kellogg switchboard of 2,160 drops. It has 2,000 subscribers. Connection is made with the long distance company now being built here. Rates, $48 and $24. The switchboard capacity is to be increased to 3,360 lines.

DAYTON, OHIO.—The Montgomery County Telephone Company has been incorporated with $20,000 by L. Raugh, H. C. Kiefaber, J. T. Barlow, Edward Canby and others. The company will build telephone lines throughout Montgomery County and will operate in connection with the Dayton Home Telephone Company.

CLEVELAND, OHIO.—The directors of the United States Telephone Company have decided to make a new issue of $500.000 of 6 per cent, preferred stock. The stock of this company is owned wholly by the Federal Telephone Company and the new issue will be used to liquidate certain of the debts of the latter company.

PORTLAND, ORE.—The City Council has sustained the mayor in his veto of the ordinance granting a franchise to the Hoosier Telephone Company. A new franchise ordinance will be passed with provisions regulating the rate to be charged and limiting the time of completion. The managers of the new company say they are now ready to contract for the erection of wires and construction of the system which is to cover 21 counties.

OTTAWA, ONT.—The thriving towns of Port Arthur and Fort William, at the head of Lake Superior, are eminently satisfied with the principle of municipal ownership, having given it a thorough test not only as to water works and electric light, but also latterly in the matter of a telephone service. Fort William installed its own telephone system, in opposition to the Bell Company in December last. The central energy system was put in at a cost of about $15,000, including central equipment, poles, lines, and telephone boxes complete. There are already some 350 subscribers and the present income derived amounts to $5,000 per year at $1 per month for domestic and $2 for business telephones. The apparatus was furnished by the International Telephone Company, of Chicago. Port Arthur, which is three miles distant from Fort William, has a similar system and there is free exchange between the two towns. By parliamentary enactment neither town may sell, lease or impair its system without the consent of the majority of ratepayers of both towns. The cost of maintaining the system is not over $3,500 per annum for each town, which also includes interest and sinking fund payments on 20-year debentures, provision for depreciation of plant and operating expenses. It is fully expected that by the end of the current year, the system will be earning from $1,000 to $1,500 net profit to each of the towns.

ROBY, TEX.—The Orient Telephone Company has been incorporated by A. L. Green and others. The capital stock is $20,000.

PARIS, TEX.—The American Long Distance Telephone Company has been incorporated here with a capital stock of $50,000. Mr. A. H. O'Neill is one of the directors.

SHREWSBURY, VT.—The Cuttingville & Shrewsbury Telephone Company has 15 subscribers and 10 miles of toll line. It rents instruments from the New England Telephone Company for the privilege of switching on to its lines.

POMFRET, VT.—The Union Telephone Company owns 20 miles of toll line and has 28 subscribers. It is a private concern, mostly farm lines, extending to stores, post offices, railroad stations, doctors, etc., for the convenience of the subscribers.

NEBAGAMON, WIS.—A local telephone company has been formed at this place.

PLEASANT PRAIRIE, WIS.—The Pleasant Prairie Telephone Company has been incorporated with a capital stock of $3,000. Mr. H. Crowe is one of the directors.

MILWAUKEE, WIS.—The Diamond Grove Telephone Company of Miflin has been incorporated with a capital of $1,000. Mr. H. A. Rundell is one of the directors.

ELECTRIC LIGHT AND POWER.

OZARK, ALA.—Bids are wanted by Marion McDonald, Supt. Water Works, for the construction of an electric light plant, to cost about $8,000. Bids will be received for the entire contract, or for all material at a specified price for the city to install.

CORONA, CAL.—F. C. Cooper has applied for a franchise for an electric light and power plant.

SAN FRANCISCO, CAL.—The California Power & Development Company has been incorporated to supply certain sections of the State with electrical and water power; capital, $2,000,000. Directors: K. H. Plate, of San Jose; J. I. Hohn, of Oakland; R. E. Filcher, of San Francisco, and others.

GLENWOOD SPRINGS, COLO.—The Colorado Power & Irrigation Company has been incorporated with a capital of $5,000,000. It will receive its power from Shoshone Falls, nine miles east of Glenwood Springs, and expects to secure 40,000 horse-power. At first power will be supplied to Leadville, Aspen and the surrounding towns, but later will be transmitted to Denver. Incorporators: Albert Sherwin, Leadville; J. R. De Remer and E. E. Lucas, of Glenwood Springs.

NEW MILFORD, CONN.—A bill has been passed in Legislature authorizing the New Milford Power Company to erect a dam at Gaylord's Bridge on the Housatonic River.

GRIFFIN, GA.—The citizens have voted to issue $100,000 bonds for lights, water and sewerage.

SAND POINT, IDA.—The Sand Point Electric Company is reported incorporated, with a capital of $25,000, by T. C. Marshall, R. G. Rowland and M. R. Rutherford.

CHERRY VALLEY, ILL.—It is reported that C. K. Luhman contemplates constructing an electric light plant.

ALTON, ILL.—The city is preparing to re-let the city lighting contract for another year, a long time contract with the Alton Railway, Gas & Electric Company having expired.

BEDFORD, IND.—It is stated that the Bedford Electric Light & Power Company contemplates extensive improvements.

LOGANSPORT, IND.—The city council has ordered the city clerk to advertise for bids for the furnishing of two high-pressure boilers for the electric light plant, each having a capacity of 350 horse-power.

BUTLER, IND.—This city has purchased the local electric lighting plant of W. H. McIntire for $9,400. In consequence of the sale the injunction suit brought by McIntire has been dismissed. The plant will be operated as a municipal venture.

CONVERSE, IND.—A stock company has been organized here to purchase for $6,000 the local electric light plant. The company will build a new powerhouse and operate the plant in connnection with the telephone system, which it has also acquired.

RICHMOND, IND.—The report of the municipal electric lighting plant for the year ending May 31, shows that the receipts have been a little more than expenses, notwithstanding the temporary loan made for its betterment. Mayor Zimmerman opposes the employment of a general manager on the ground that it would add another name to the pay roll, and make it that much harder to show a profit. The commissioners are capable of handling the plant without a general manager, he says.

DES MOINES, IA.—The Edison Electric Light Company is having plans prepared for an extension to the east wing of the Center Street dam, at a probable cost of $50,000.

HORTON, KAN.—The Horton Water & Light Company, of Horton, has been incorporated, with a capital of $60,000.

JACKSON, KY.—The Jackson Electric Light & Power Company is stated to has secured a charter to operate an electric light plant in Breathitt County, Ky., and other places; capital, $25,000. Incorporators: Louis B. Dailey, M. Mitchell and others, all of Jersey City, N. J.

GREENFIEL,D MASS.—The Greenfield Electric Light & Power Company is stated to have purchased water power at Gardner Falls, and will expend about $75,000 in the construction of a dam, canal and power plant.

MERIDA, MEXICO.—A large electric light and power plant is being installed here by the Siemens & Halske Company. It will replace the plant of the company which recently went into bankruptcy.

GUANAJUATO, MEXICO.—It is stated that the Guanajuato Power & Electric Company will have its great electric plant completed by August 1 of this year. The falls where the plant is being built and where the electrical energy will be generated are situated on the Duero River, near the city of Zamora, a distance of 110 miles from this city to which place the transmission lines will extend. H. H. Filley is chief engineer. The copper cables will rest on steel towers, each 46 feet high. These towers have already been erected.

ONTONAGON, MICH.—The Diamond Match Company will install an electric light plant.

BOYNE, MICH.—E. A. Stowe and C. C. Follmer, of Grand Rapids, are reported interested in the construction of an electric light and power plant at Boyne.

BOONEVILLE, MISS.—The Booneville Electric Light & Power Company operates a 100-drop board with 258 subscribers and 156 miles of toll line. The company expects to double its system this year owing to the great demand for telephones.

BOZEMAN, MONT.—The People's Electric Light & Power Company, of this place, has filed articles of incorporation. The capital stock is $50,000 and the incorporators are F. L. Benepe, George Flanders and G. L. Hogan.

FORT STANTON, NEW MEX.—An electric light plant is to be installed here. M. H. Fisher is interested.

PENN YAN, N. Y.—The Village Trustees are reported to be considering the question of installing an electric light plant.

NIAGARA FALLS, N. Y.—Bids are wanted by the Toronto & Niagara Power Company for a power wheel pit. It will be 480 feet long, 180 feet deep, and 27 feet wide, cut through solid rock. It will cost about $1,250,000, and will develop 225,000 horse-power.

LEXINGTON, N. C.—The Lexington Water & Light Company, capital $75,000, has been chartered by F. W. Subert, of Waterbury, Conn. W. G. Penry and others.

PORTSMOUTH, OHIO.—L. E. Smith and others are stated to have petitioned for a franchise for a lighting plant.

WILLIAMSBURG, OHIO.—The village has voted favorably on a proposition to issue bonds for the purpose of building a municipal lighting plant. Plans are being prepared.

BAKER CITY, ORE.—The Rock Creek Power & Transmission Company has commenced work on the installation of an electric power plant at Rock Creek. The incorporators are Al. Welsh, A. Lennox, W. H. Shumaker and W. H. Gilbert. Power will be transmitted to this city for the operation of its lighting and street railway systems. A site for the plant has been purchased and the necessary machinery has been ordered from the East.

LEBANON, PA.—The Edison Company has secured the contract for lighting the city for ten years at $79.92 per light per year for arc lights and $16.80 for incandescents.

LEXINGTON, S. C.—The Lexington Water Power Company has applied for a charter. The capital will be $50,000. C. G. Guignard, G. A. Guignard and others are interested.

SAN ANTONIO, TEX.—W. H. Weiss has petitioned the City Council for a franchise for an electric light plant.

KYLE, TEX.—T. C. Johnson, of San Marcos, writes that it is proposed to construct an electric light plant to light oil mill property.

BAY CITY, TEX.—The Bay City Ice, Light & Power Company has been organized here with a capital stock of $50,000. I. Marks is president.

CLARKSVILLE, TEX.—The Clarksville Light Company has been organized here for the purpose of installing an electric light plant. It has a capital stock of $30,000. The incorporators are B. S. Silvey and W. H. Miller, of Clarksville; R. W. Wortham, of Paris, Texas.

PETERSBURG, VA.—It is stated that the Virginia Passenger & Power Company will build a dam across Appomattox River west of the dam above Ferndale Park.

SPOKANE, WASH.—The Washington Water Power Company will construct an electric plant at Post Falls, to cost $500,000.

ONALASKA, WIS.—The City Council has granted the La Crosse Gas & Electric Company a franchise to install an electric lighting system in Onalaska.

INDEPENDENCE, WIS.—The Village of Independence will receive bids July 14 for constructing a complete electric light building, pole line, 70-h.p. boiler and engine and 40-kw. dynamo and switchboard.

THE ELECTRIC RAILWAY.

SANDERSVILLE, GA.—The City Council has granted a franchise for the building of an electric railway between Sandersville and Tennille. The promoters of the enterprise are Jeff. A. Irwin and Lake B. Holt.

HONOLULU, HAWAII.—The Public Works Department has approved of the plans of the Rapid Transit Company for its proposed street car route along the water front.

ALTON, ILL.—Announcement has been made of the proposed consolidation of the Alton & East Alton Railway & Power Company and the Alton Railway, Gas & Electric Company.

CHICAGO, ILL.—The directors of the Northwestern Railway have decided to make the extension to Ravenswood an elevated structure the entire distance. The extension will be a little over one and three-quarters miles long and the cost will be about $1,300,000. The money will be obtained through a sale of bonds.

CHICAGO, ILL.—The South Side Suburban Railway Company has been incorporated with a capital stock of $50,000. The incorporators and first board of directors are Cornelius J. Ton, Charles C. Heisen, Frederick C. Bendle, Clayton R. Taylor and Gustav Nelson, of Chicago. It is proposed to construct a road from a point in the City of Chicago to the boundaries of Cook County.

EAST ST. LOUIS, ILL.—The Interstate Transit Co., of East St. Louis, which formerly conducted automobile traffic on the Eads Bridge, has secured a 50-year franchise for an electric light and power plant on the East Side. The company, of which L. G. McNair, of St. Louis, is president, agrees to give the city of East St. Louis two per cent. of its gross earnings during the first ten years of the life of the franchise and five per cent. during the succeeding ten years.

NEW YORK, N. Y.—The Escalator at the Twenty-third Street station of the Sixth Ave. Elevated Railway, which has been shut down recently has now resumed regular operation. Some time ago the motor driving the escalator was connected to take current from the third rail. It was found, however, that the voltage fluctuates over a considerably wider range than had been anticipated and the shut down was necessary in order that alterations might be made in the motor to secure better speed regulation.

NEW INDUSTRIAL COMPANIES.

THE UNDERWRITERS' ELECTRIC COMPANY, Chicago, has been incorporated, with a capital of $2,500. It is proposed to manufacture electrical apparatus. The incorporators are F. S. Munro, J. Hall and C. M. Thompson.

THE WELLINGFORD MICA & MINING COMPANY has been established at Ottawa, Ont., with a capital of $500,000. The directors are all Americans. They are Messrs. Shirley, Seamans, Gibb and Floyd, all of Boston, Mass. The company is incorporated under the laws of the State of Maine. The product of the company's mica mines, which are situated near Ottawa, will be principally manufactured for electrical purposes.

LEGAL.

TIME RECORDERS.—On June 30, 1903, U. S. Circuit Court, Boston, Judge Hale, granted a preliminary injunction against John C. Wilson doing business as the Automatic Time Stamp Company, restraining him from the manufacture and sale of an instrument for measuring and recording elapsed time called "The Timometer" for infringement of patents Nos. 424,291 and 583,320, owned by the Calculagraph Company.

ELECTRICAL WORKERS BOYCOTT ILLEGAL.—Attorney-General Bell, of Texas, and District Attorney Bee, of Bexar County, in that State have brought suit against the Electrical Workers' Union, of San Antonio, Texas, under the Anti-Trust law for $6,000 penalty for conspiracy and an injunction to prohibit a boycott by the union or its members. When the Anti-Trust law was passed, the labor unions protested against it, declaring that it would operate unfavorably against them, and they asked that they be exempted from the provisions of the statute. Gov. Lanham opposed this and expressed the opinion that the law could not interfere with workingmen in their rights and privileges. The suit brought by the Attorney-General shows that these rights do not include the boycott. The present case arose over the boycott of the Herf Building, a big business block in the best business part of the city, which was boycotted by the unions because the electric wiring was done by a firm that was on the union's unfair list. Negotiations were pending for the lease of the building when the parties who wanted to lease were notified by the unions they would be boycotted if they attempted to do business in the structure. This threat caused the proposed lease to fall and no man or firm will now lease the block. The matter was placed before the Attorney-General, who at once filed a suit against the boycotting union.

PERSONAL.

MR. S. F. B. MORSE, assistant passenger traffic manager of the Southern Pacific Railway, with headquarters in Houston, Tex., has tendered his resignation, to take effect on Aug. 1. Mr. Morse went to the Huntington lines from the Big Four.

MR. WILLIAM CURRIE, of the Stanley Electric Mfg. Company, who, for some time past, has been at the Pittsfield works as Mr. C. C. Chesney's assistant has been appointed sales engineer of the Chicago office of the company.

MR. H. F. SANVILLE, of Philadelphia, has been fortunate in securing the services of Mr. A. E. Meixell to represent his various lines of street railway supplies throughout the country. Mr. Meixell was, until very recently, superintendent of the Fairmount Park Transportation Company. He has just returned from his maiden trip, on which he met with decided success.

SKINNER & SETHMAN, consulting and contracting engineers of Denver, Colo., have recently secured a contract for installing an electric light and power plant of the Pueblo Insane Asylum. The generating units will consist of two Chase simple engines, direct-connected to 250-kw, 250-volt Crocker-Wheeler generators. The contract includes the wiring of the grounds for 16 arcs and the wiring of the buildings for about 1,000 incandescents, all wires being placed in conduit. Some motors are to be installed later. The contract price is $12,850.

MR. J. D. MAGUIRE, who has been for some time president of the Magnet Wire Company, of New York, has resigned his position with that company and become associated with the National Electric Company, of Milwaukee, Wis., the successor of the Christensen Engineering Company. Mr. Maguire's office is at 135 Broadway, New York. As was announced in these columns recently the National Electric Company was organized by the interests in control of the Christensen Company and took over the control and management of the latter concern. It is now continuing the manufacture of the Christensen Company's air brakes and electrical apparatus. By securing Mr. Maguire's services and experience the National Company acquires an added element of strength in its business organization.

MR. W. E. COREY, president of the Carnegie Steel Company, has just been selected as assistant to President Schwab, of the United States Steel Corporation. In a biographical sketch of his as chemist, laboratory expert, practical manager, etc., the New York *Herald* says: "It was during his administration that the old trouble in annealing plates was corrected. Previously many armor plates had been spoiled by overannealing, which resulted in cracking, and by underannealing. It was largely a matter of guesswork when a plate was properly annealed. This meant the loss of thousands of dollars in the long delays incident to the tardy process or armor manufacture. Mr. Corey sought Professor R. A. Fessenden, of wireless telegraphy fame, then professor of electrical engineering at the Western University, and together they invented a scheme for the introduction of one end of a wire in the annealing furnace, and the exposure of the other end in the cold air outside of the mill. A heat measuring device in the center of the wire told the heat of the furnace. It has since saved small fortunes annually."

OBITUARY.

MR. J. A. HESSE, of Atlanta, Ga., died suddenly in Boston, June 29, while on a business trip to that city. Mr. Hesse had been identified with the commercial side of the electrical industries for many years, and for the past four years represented the Fort Wayne Electric Works in the South. He was very well known to many of the pioneers in the trade and this notice will be read with sorrow by a large circle of friends throughout the United States. The funeral was held at Lima, Ohio, Thursday, July 2.

MR. GEORGE S. MORRISON, the celebrated civil engineer and bridge builder, died last week. He was at one time president of the American Society of Civil Engineers and was well-known among electrical engineers. Five bridges across the Mississippi, ten across the Missouri, and many other important structures are his most fitting monuments. The most important work being the bridge at Memphis, with a single truss span of 790 feet. He served as a member of the Isthmian Canal Commission, as a member of the commission appointed by President Cleveland to locate a deep-water harbor in Southern California, as consulting engineer of the Dock Department of New York, and in other distinguished capacities.

EDUCATIONAL.

OHIO STATE UNIVERSITY.—Prof. H. B. Brooks reports the following graduates in electrical engineering this commencement from the Ohio State University, Columbus, Ohio. F. R. Kunkel, Instrument Standardizing Dept., Westinghouse Electric & Manufacturing Co., Pittsburg. C. B. Ross, with Hoppes Mfg. Co., Springfield, Ohio. R. D. Nye, apprentice, Westinghouse Electric & Mfg. Co., Pittsburg. W. R. Youmans, apprentice, General Electric Co., Schenectady, F. M. Webber, with Ft. Wayne Electric Works, Ft. Wayne, Ind. G. L. Mooney, not located, home address, Woodsfield, Ohio. C. F. Sloctemyer, with Jeffrey Mfg. Co., Columbus, Ohio. H. B. Brooks, laboratory assistant, National Bureau of Standards, Washington, D. C.

Trade Notes.

THE HEINE SAFETY BOILER COMPANY, St. Louis, Mo., has increased its capital stock from $430,000 to $500,000, 60 per cent. of the increase being paid up.

THE ELECTRIC CHAIR COMPANY, of St. Louis, Mo., increased its capital stock from $75,000 to $500,000, $200,000 of the increase to be preferred stock at 8 per cent.

REMOVAL.—The Boston office of the Gould Storage Battery Company has been moved from 53 State Street to more commodious quarters at 89 State Street in the Fiske Building.

THE WESTERN ELECTRIC COMPANY has added two handsome pamphlets to its attractive line of trade literature. No. 3030 is on the subject of sewing machine motor equipments and the other (No. 6005) relates to automatic circuit breakers for direct current. Both catalogues are completely illustrated with half-tone views and diagrams.

THE NORTHERN ELECTRICAL MFG. CO., Madison, Wis., in leaflets Nos. 100, 101, 102 and 103, illustrate the application of Northern motors to the operation of a cement mill; a portable radial drill, the driving of a collar and cuff ironer in laundry work and the driving of a 28-in. lathe, respectively. The principal features of construction of the motors and their adaptability are briefly pointed out.

AMMETERS AND VOLTMETERS.—The Jewell Electrical Instrument Company, Chicago, Ill., in its circular No. 1050, illustrates and describes the Jewell circuit-breaking ammeters and voltmeters, which are designed for the protection of the various forms of electrical apparatus and for the automatic handing of electricity. This device was described and illustrated in our issue of April 4, 1903.

THE C. W. HUNT COMPANY, West New Brighton, Staten Island, N. Y., in pamphlet No. 034, just issued, describes and illustrates very completely the different forms of industrial railways for manufacturing establishments, and in catalogue 035 the subject of coal handling machinery is gone into very thoroughly. The illustrations in both publications show many actual installations and the various types of apparatus, etc., used.

COLORS AND SPECIFICATIONS.—The Joseph Dixon Crucible Company, Jersey City, N. J., is sending out a new folder entitled, "Colors and Specifications." In it are contained five examples of steel and iron construction which have been painted with Dixon's protective paints. The folder contains samples of four colors of Dixon's silica graphite plant for steel and iron construction, tin, iron and shingle roofs. The specifications suggest best methods for construction and maintenance in the painting of steel and iron. This company has had an experience of forty years in the manufacture of protective paint.

PITTSBURG TRANSFORMERS.—The Pittsburg Transformer Company is sending out a circular giving a copy of a letter from the Atlantic Coast Electric Light Company, Asbury Park, N. J., which speaks very favorably of Pittsburg transformers. The point is made that in five years' time not a single Pittsburg transformer has been burned out, nor has any of them caused the slightest trouble. Mr. A. H. Mustard, 120 Liberty Street, New York, is sales agent for the Pittsburg Transformer Company. Mr. Mustard will be very glad to send a copy of this circular to any one interested in the subject of transformers.

THE COPENHAGEN AUTOMATIC FIRE ALARM CO., Sheboygan, Wis., has just issued an interesting and attractive pamphlet descriptive of the "Copenhagen" automatic fire alarm. On the principle that an ounce of prevention is worth a pound of cure this device stands on ground that cannot be shaken. The manufacturers point out how it has saved much valuable property from destruction by the simple function of ringing an alarm when undue heat is present. With so simple a device there seems to be no excuse for permitting property to go unprotected against fire. Everyone interested should look into the merits of the "Copenhagen." A copy of the catalogue tells what it has done and what it will do.

THOMAS E. CLARK WIRELESS TELEGRAPH-TELEPHONE COMPANY, of Detroit, Mich., represented by G. F. Riefstahl, secretary, and Ackling Stirling, exhibited several of its wireless telegraph sets at the recent independent telephone convention in Chicago. One very compact set, intended for schools and colleges, and other light experimental work in wireless telegraph attracted much attention on account of its reasonable price and efficiency. This outfit was contained in two cases about the size of an ordinary dress suit case. The company also makes larger apparatus good for operation up to ten miles. All these sets were shown in working order, one set with a recording tape in connection.

UNDERGROUND CONDUITS.—The American Stone Conduit Company, of Chicago, is manufacturing an underground conduit that is rapidly growing in popularity with electrical and contracting engineers and electric lighting, power, telephone, telegraph and street railway companies. This conduit is made in single duct, 6 ft. lengths, 4½ in. in diameter, with a 3⅛ in. bore, the materials of construction being crushed limestone and the best quality of Portland cement. In the process of manufacture the conduit is subjected to an interior pressure of 3,500 pounds per square inch, giving great strength to the walls and a highly polished inner surface. In a recent pamphlet issued by the company are given six illustrations of actual installations of these conduits, besides others showing the construction of the conduit, method of making joints, etc. The company's office is at 94 La Salle Street, Chicago.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JUNE 30, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

731,805. TELEPHONE-NOTATION REGISTER; Joseph P. McKee, Allegheny, Pa. App. filed April 21, 1902.

731,899. ELECTRICAL INDICATOR FOR TELEPHONIC TOLL-COLLECTING DEVICES; Romeo B. Hazlett, Philadelphia, Pa. App. filed Jan. 30, 1902.

732,014. INDUCTION COIL; John Splitdorf, New York, N. Y. App. filed April 8, 1903. A supplemental condenser is used in parallel with the main condenser and the circuit breaker, the purpose being to insure a strong discharge across the points. (Issued June 23.)

732,047. ELECTRODE; William R. Chipman, New York, N. Y. App. filed May 8, 1902.

732,062. POWER TRANSMISSION AND CONTROL; Justus B. Entz, Philadelphia, Pa. App. filed March 29, 1898. (See Current News and Notes.)

732,088. INSULATOR FOR HIGH-TENSION CURRENTS; Karl Selim Lemstrom, Helsingfors, Russia. App. filed September 9, 1902. (See Current News and Notes.)

732,098. CENTRAL-ENERGY TELEPHONE SYSTEM; Kempster B. Miller, Chicago, Ill. App. filed February 4, 1901.

732,114. MAINTAINING SYNCHRONOUS ROTATION OF DYNAMO-ELECTRIC MACHINES; Edwin W. Rice, Jr., and Ernest J. Berg, Schenectady, N. Y. App. filed Aug. 28, 1899. (See Current News and Notes.)

732,130. SYSTEM OF CONTROL FOR ELECTRICALLY-PROPELLED TRAINS; Elmer A. Sperry, Cleveland, Ohio. App. filed Sept. 14, 1898. (See Current News and Notes.)

732,131. SELECTIVE PARTY-LINE TELEPHONE SYSTEM; Albert J. Springborn, Cleveland, Ohio. App, filed June 12, 1901.

732,141. ELECTRIC-ARC LAMP; Christian J. Toerring, Philadelphia, Pa. App. filed June 25, 1902. (See Current News and Notes.)

732,144. TROLLEY; John H. Walker, Lexington, Ky. App. filed March 14, 1902. A construction of harp and wheel hub affording good contact and lubrication.

732,145. TROLLEY; John H. Walker, Lexington, Ky. App. filed Nov. 20, 1902. A modification of the preceding patent.

732,147. TELEPHONE-TRANSMITTER; Mathias Weisser, Milwaukee, Wis. App. filed Jan. 11, 1902.

732,153. INDUCTION MOTOR; Andrew E. Averrett, Schenectady, N. Y. App. filed April 21, 1903. To prevent an initial rush of current at starting, a portion of the secondary winding is made of iron, replacing the usual copper and thus introducing a resistance which keeps the current down.

732,157. ELECTRIC RAILWAY; Arthur B. Bedworth, Boston, Mass. App. filed Nov. 13, 1902. A car entering a block on a single track railway cuts off current from a short section of the track in the block ahead to prevent other cars entering the block from the opposite direction.

732,170. ELECTRIC SWITCH; Theodore O. Chouinard, Quebec, Canada. App. filed June 21, 1902. Details.

732,171. BRUSH HOLDER; Alexander Churchward, Chicago, Ill. App. filed Nov. 13, 1899. The carbon brushes can be removed from the holder and replaced without altering the spring tension.

732,174. AUTOMATIC CUT OUT DEVICE FOR ELECTRICAL TRANSFORMERS; De Witt C. Conkling, Cincinnati, Ohio. App. filed July 2, 1902. Shutting off current from the last lamp, automatically opens the primary circuit, thereby cutting out the transformers and upon again closing the secondary or service circuit at any point, the primary circuit is likewise closed through the transformer.

732,176. COMPENSATING FRICTION IN ELECTRIC METERS; Frank P. Cox, Lynn, Mass. App. filed Jan. 22, 1902. (See Current News and Notes.)

732,182. ELECTRIC ARC LAMP; Richard Fleming, Swampscott, Mass. App. filed Jan. 30, 1901. The principal improvements consist of spring-supports for the magnet spools, spring-connections between the armatures and connecting rods, and a balanced rocker-arm connecting the series and shunt armatures with an adjustable weight to enable the lamp to be adjusted to the proper strength of current.

732,196. TERMINAL SOCKET; Carl Leichtenschlag, Berlin, Germany. App. filed March 10, 1900. A lamp receptacle in which the threaded sleeve has extending portions interlocking with cavities in the porcelain base to fasten it thereto.

732,200. ARMATURE; John A. Little, St. Louis, Mo. App. filed Sept. 20, 1902. An armature core built up of uniform sections, any of which may be readily removed and replaced.

732,201. ELECTRIC CONTROLLER; John A. Little, St. Louis, Mo. App. filed March 16, 1903. Details.

732,204. PHASE TRANSFORMATION; Alexander D. Lunt, Schenectady, N. Y. App. filed June 25, 1900. Consists in combining magnetic fluxes having phase relations corresponding to those of the currents of a polyphase system of a given number of phases and inducing by the resultant fluxes electromotive forces having a different number of phases.

732,235. ELECTRIC MOTOR; Peter Swan, Calcutta, India. App. filed Jan. 13, 1903. The commutator segments have longitudinal holes terminating in enlarged cavities, to receive the ends of the armature conductors.

732,238. AUTOMATIC REGULATOR FOR ELECTRIC GENERATORS; William A. Turbayne, Buffalo, N. Y. App. filed July 19, 1902. (See Current News and Notes.)

732,239. AUTOMATIC REGULATOR FOR ELECTRIC GENERATORS; William A. Turbayne, Buffalo, N. Y. App. filed July 31, 1902. (See Current News and Notes.)

732,240. BRUSH HOLDER; Louis E. Underwood, Lynn, Mass. App. filed May 19, 1902. A construction whereby the pressure on the brush in the direction of commutation and the pressure in the direction transverse thereto are maintained at a definite relation to each other.

732,247. CONTROLLER FOR ELECTRIC MOTORS; Eddy R. Whitney, Swampscott, Mass. App. filed May 2, 1903. A controlling switch adapted to connect the motor across low potential mains to obtain a certain speed and then connect it across higher potential mains, a variable field being used on each circuit to further increase or vary the speed.

732,253. CIRCUIT BREAKER; Henry P. Ball, New York, N. Y. App. filed Jan. 29, 1902. An operating handle for the switch blade which will exert a gradually increasing leverage thereupon.

732,254. CIRCUIT BREAKER; Henry P. Ball, New York, N. Y. App. filed April 18, 1902. Details of the latch-releasing mechanism of an underload circuit breaker.

732,255. OIL-SWITCH; Henry Price Ball, New York, N. Y. App. filed Aug. 18, 1902. (See Current News and Notes.)

732,272. SIGNALING SYSTEM; Harold G. Brown, Melrose, Mass. App. filed Oct. 10, 1902. In railway systems employing a direct current for both power and signal service, the object is to prevent the return current in the rail from operating the signal system when a part of the circuit of the latter includes the rail.

732,273. ELECTROMAGNET; Charles A. Brust, Memphis, Tenn. App. filed Aug. 21, 1902. A special form of magnet intended to remove iron particles from cotton-seed as it is fed to the crushing mill.

732,282. ALARM CLOCK; William Edwards, Easton, Pa. App. filed Nov. 7, 1902. A burglar alarm in connection with a lock, the signal at the same time serving as an ordinary door bell.

732,284. TELEPHONE TRANSMITTER; Ernest B. Fahnestock, New York, N. Y. App. filed May 7, 1900.

732,285. TELEPHONE TRANSMITTER; Ernest B. Fahnestock, New York, N. Y. App. filed Dec. 5, 1901.

732,286. TELEPHONE TRANSMITTER BASE; Ernest B. Fahnestock, New York, N. Y. App. filed Oct. 7, 1902.

732,287. TELEPHONE HOOK SWITCH; Ernest B. Fahnestock, New York, N. Y. App. filed Oct. 25, 1902.

732,346. ELECTRIC IGNITER; Albert F. Ganz, Hoboken, N. J. App. filed Jan. 29, 1903. An improvement upon the Le Pontois magneto-sparker whereby each impulse of current generated may be of longer duration than is afforded by the aforesaid device.

732,351. SYSTEM OF MOTOR CONTROL; George H. Hill, Schenectady, N. Y. App. filed April 1, 1903. A hoisting motor in which the field is connected constantly across the supply mains, so that when the armature is short circuited for braking purposes, the field will not be affected by armature currents.

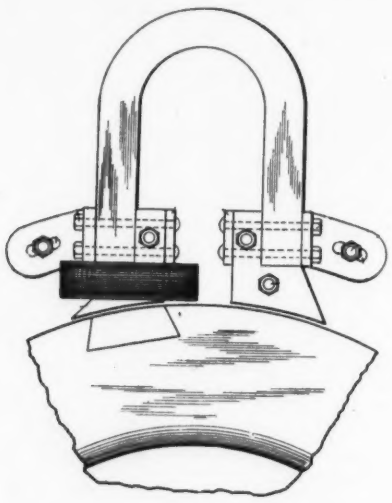
732,364. ELECTRIC IGNITER; Herbert G. Mears, New York, and Henry W. Aylward, Brooklyn, N. Y. App. filed Nov. 19, 1902. An improvement upon the Le Pontois igniter with the object of simplicity of construction.

732,365. IGNITER FOR INTERNAL COMBUSTION ENGINES; Herbert G. Mears, New York, and Henry W. Aylward, Brooklyn, N. Y. App. filed Nov. 19, 1902. A further improvement of the Le Pontois igniter by which the timing of the ignition can be accurately and readily effected.

732,366. ELECTRIC IGNITER; Herbert G. Mears, New York, and Henry W. Aylward, Brooklyn, N. Y. App. filed April 3, 1903. A further improvement in the Le Pontois igniter wherein the pole pieces of the magnet are arranged parallel to the axis of rotation and upon the opposite sides of an inductor in the shape of a disk.

732,371. GENERATOR FOR ELECTRIC IGNITERS; Leon J. Le Pontois, New York, N. Y. App. filed Feb. 15, 1902. The ignition device referred to in above patents and consisting essentially of a rotating magnetic inductor having a cutaway peripheral portion and moved with respect to a coil carried by a stationary magnet so as to generate impulses for igniting the explosive charges in a gas cylinder. The engine fly-wheel is preferably used as the inductor.

732,372. GENERATOR FOR IGNITERS; Leon J. Le Pontois, New York,



732,371.—Generator for Electric Igniters.

N. Y. App. filed Aug. 8, 1902. A modification of the preceding invention.

732,377. ELECTRICAL MOTOR; Harold Rowntree, Chicago, Ill. App. filed Nov. 15, 1899. An electric motor having its armature and field simultaneously revoluble in opposite directions, in combination with a hoisting mechanism, driven faster by one of said parts than by the other, and with means whereby the slow-driving part may be actuated and its brake released without releasing the brake of the fast-driving part.

732,410. MANUFACTURE OF SILICON AND ALUMINUM FROM SILICATES OF ALUMINA; Christian Harrebow Homan, Christiania, Norway. App. filed Oct. 13, 1902. (See page 62.)

732,443. TELEPHONE; Fred C. Redfield, Nashua, N. H. App. filed April 3, 1902.

732,449. TELEPHONE TRANSMITTER AND RECEIVER; Oliver P. Sammons, Denison, Tex. App. filed July 14, 1900.

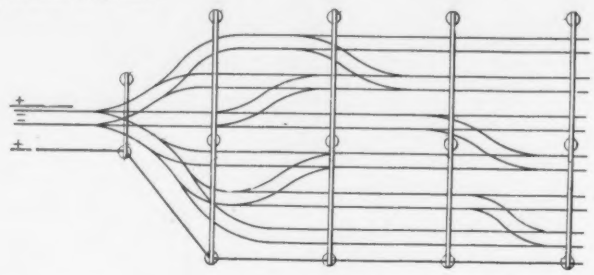
732,477. ELECTRIC SWITCH; Isaac G. Waterman, Santa Barbara, Cal. App. filed Aug. 2, 1902. Details of a push switch.

732,488. ELECTRIC-ARC LAMP FOR CONSTANT-POTENTIAL- CIR CUITS; James J. Wood, Fort Wayne, Ind. App. filed June 14, 1902. (See Current News and Notes.)

732,489. RHEOSTAT FOR ARC-LAMPS; James J. Wood, Fort Wayne, Ind. App. filed April 25, 1903. (See Current News and Notes.)

732,495. TROLLEY; George E. Ailen, Pittsburg, and George Zimmer, Allegheny, Pa. App. filed April 15, 1903. Details of a device for retaining the wheel on the wire.

732,512. ELECTRIC RAILWAY; Edward C. Boynton, Newburgh, N. Y. App. filed March 5, 1903. In a train or switching yard, the current for the switching engine is carried by overhead rails extending across all of the tracks and the locomotive carries a shoe long enough to bridge from one rail to another, thus receiving current at all times without the necessity of overhead switches.



732,512.—Electric Railway.

732,559. ELECTRIC SIGNAL; George F. Hilton, St. Augustine, Ill. App. filed July 21, 1902. An electric bell is put into circuit with a bond, one terminal of which is insulated from the rail but mechanically connected therewith by the car wheel, the signal being used to indicate the approach of the train.

732,586. SAFETY DEVICE FOR ELECTRIC ELEVATORS; Gustaf T. Rennerfelt, Brooklyn, N. Y. App. filed Sept. 17, 1902. The brake magnet is in series with two circuits, one of which is open while the motor is driven as a generator, while the other is opened whenever the main circuit is interrupted, the object being to prevent the disablement of the brake in case the main circuit is opened while the motor is being driven as a generator.

732,598. CLIP; Louis Steinberger, Brooklyn, N. Y. App. filed Sept. 12, 1902. The connection between the ear which holds the trolley wire and the clip is more or less yielding to provide for strains brought upon the ear by the trolley wheel.

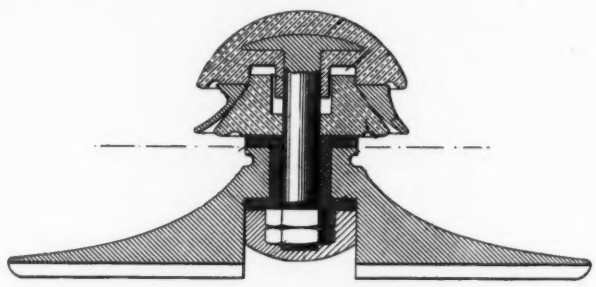
732,599. TURNBUCKLE STRAIN; Louis Steinberger, New York, N. Y. App. filed Feb. 24, 1903. Details.

732,608. ELECTRICAL CONTACT CONTROLLING FLOAT; Isaac G. Waterman, Santa Barbara, Cal. App. filed Aug. 4, 1902. Details.

732,616. METHOD OF APPLYING HEAT TO ELECTROLYTES; Charles Frederick Burgess and Carl Hambuechen, Madison, Wis. App. filed March 12, 1903. (See page 62.)

732,619. CONTROLLER FOR ELECTRIC HOISTS; Philip J. Darlington, Glenridge, N. J. App. filed Oct. 3, 1902. A reversing cylinder controller having a contact adapted to shunt the armature of the motor in downward running.

732,631. ASYMMETRIC CONDUCTOR; Carl Hambuechen, Madison, Wis. App. filed Jan. 19, 1903. (See page 62.)



732,598.—Clip.

732,644. SWITCH FOR DOUBLE FILAMENT ELECTRIC LAMPS; Levi Lobenthal, New York, N. Y. App. filed Dec. 30, 1902. A switch for throwing in either filament as desired.

732,648. TELEGRAPHIC TRANSMITTER; Horace G. Martin, Brooklyn, N. Y. App. filed Oct. 6, 1902. The transmitter is constructed to make all dots automatically, leaving it in the power of the operator to adjust the length of the dot, the idea being to relieve the operator of some of the nervous strain involved in the operation of an ordinary Morse key.

732,654. MEANS FOR MAINTAINING SYNCHRONOUS ROTATION OF DYNAMO-ELECTRIC MACHINES; Edwin W. Rice, Jr., and Ernest J. Berg, Schenectady, N. Y. App. filed Aug. 28, 1899. (See Current News and Notes.)

732,665. INSULATING SYSTEM FOR ELECTRIC TRANSMISSION CIRCUITS; Alvah W. Underwood, Pittsfield, Mass. App. filed Dec. 18, 1902. The main insulator is supported upon a bridge whose ends are fixed to two auxiliary insulators carried by the cross arm.

732,672. ELECTRIC SWITCH; Henry P. Ball, New York, N. Y. App. filed July 6, 1900. The operative parts are constantly immersed in oil and the contacts are separated by insulating partitions to avoid any possibility of a short circuit.